NATURE

No. 4196 SATURDAY, APRIL 1, 1950 Vol. 165

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Editorial and Publishing Offices of "NATURE"
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
Telegrams: Phusis Lesquare London
Advertisements only should be addressed to:
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Telephone Number: Temple Bar 1942
The annual subscription rate is £4 10 0, payable in advance, inland or Abroad

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"LETTERS TO THE EDITORS"

FOR the past three or four years, there has been great congestion of the portion of *Nature* appearing under the title of "Letters to the Editors". Since these 'letters' have come to be regarded as the usual mode of announcement of the results of new work—interim reports in most cases—this was perhaps inevitable in view of the great outburst of scientific activity throughout the world. A further factor was the enforced reduction in size, or even the disappearance, of many of the specialist organs of scientific publication during the war period. One unfortunate result of the great pressure on our space has been the irritating but unavoidable delays in publication, which have been, and are still, a matter of grave concern to the Editors, correspondents and readers. At one period an attempt was made to reduce such delays by using smaller type, so that a greater number of letters could be fitted into the same amount of space. Experience showed, however, that the great inconvenience and strain caused by the use of this small type were not worth the space 'gained'. As soon, therefore, as more paper could be used, we reverted to the usual type and the number of pages devoted to 'letters' was increased; in recent months there have been further substantial increases in the size of that part of the journal.

The time between the date of receipt of a communication and its publication steadily increased until it became nearly six months; but happily we believe it is now decreasing. Many of the specialist journals are again active, and strenuous efforts are being made to overtake arrears. So far as *Nature* is concerned, there has always been continuous effort to ensure prompt publication—an effort in which the Editors have received every help from their printers. But it is not everywhere realized by correspondents that they also can assist in achieving this end in various ways. An important one is by making sure that their manuscripts represent their final words on what they desire to publish. In the excitement of recording new work, correspondents are apt to be impatient of all delay and to assume that the final touches can be added when they receive a proof for correction. Author's corrections on proofs are, of course, inevitable; but by reducing them to the essential minimum, much valuable time and effort can be saved at the printing works. For example, it should not be too much to expect correspondents to check numerical results and references before dispatching their manuscript; it is quite apparent, however, that some await the receipt of a proof before attending to this vital matter. It does not seem to be realized that even trivial corrections generally involve skilled handwork and often a considerable amount of resetting of type; and time spent on such tricky work means so much less time available for setting up new matter. Much editorial work would also be spared if authors would take care in their manuscripts to follow the printed style for the quotation of references, and in other minor matters, used in the journal to which they propose to submit their communication.

We are frequently asked why it is that some 'letters' in *Nature* are published relatively quickly whereas others suffer various delays. It would be easy—and also obviate considerable correspondence—to publish communications strictly in order of receipt; but the result would be very unsatisfactory in a journal covering all branches of science, for it would often happen that all the 'letters' of a single issue would be confined to, say physics, or perhaps biochemistry. Further, it should be obvious that some 'letters' are of more importance or of wider interest than others; and a series of 'letters' from different workers on a specific subject should clearly be printed as near together as possible in order to sustain the argument. For these and other reasons, the 'letters' appearing in any one issue of *Nature* represent a careful selection of the material awaiting publication.

Having indicated very briefly some of the general problems which arise in dealing with 'letters', we turn now to comment on a particular communication in the current issue (p. 522), from eleven signatories, writing from two research stations, one in the United States and the other in Great Britain, which is worthy of attention for three reasons. First, it emphasizes the fact that the estimation of vitamins—and, indeed, of all naturally occurring substances—involves not only the problem of devising a sufficiently specific and sensitive reaction for their detection; it is usually also necessary to separate them from other tissue constituents, with which they may either be merely mixed or, on the other hand, associated in compounds of greater or less stability. Sometimes a separation can be effected by simple physical processes, such as dialysis. The type of chemical procedure necessary to bring about the required degree of purification may vary from gentle enzymatic hydrolysis to vigorous treatment with strong acid or alkali. The great diversity of conditions necessary to effect the maximum amount of purification with the minimum amount of destruction is responsible for the considerable amount of work often needed to solve what is apparently a simple problem. The writers of that communication, therefore, need offer no excuse for the fact that the number of them may at first sight appear disproportionate, not so much to the interest of the problem they have tackled as to the technical difficulty of solving it. Microbiological tests, which were an essential part of their procedure, in spite of their speed and elegance, require considerable skill, some replication and the most meticulous attention to detail, especially to those details that may be varied almost without the experimenter's notice.

Secondly, that the sow and the cow should both secrete riboflavin in their respective milks was to have been expected; that, as found by Prof. R. MacVicar, Dr. S. K. Kon and their several colleagues, they secrete them at any rate partly in different forms, requiring different pre-treatment for accurate quantitative analysis, was certainly surprising and was the cause for the apparent discrepancies between results obtained in the two institutions and for their collaboration in examining those discrepancies.

The solution put forward jointly is not only gratifying in itself, as is the solution of any problem that is to some degree baffling; it also has a more profound importance. It is, indeed, the third reason for special comment on the 'letter' in question. Here were two groups of investigators, each under the leadership of a man internationally known for his work in the field, who found themselves in disagreement. Instead of indulging in polemics and, incidentally, thereby consuming a considerable amount of journal space—still all too limited, at any rate in Great Britain—they immediately got into communication with one another. By agreement they decided to collaborate in certain experiments on the cause of their difference. Having found the cause, they attached their names to a joint statement, in which they find themselves in complete agreement both as to the nature of the phenomenon they have investigated and as to its explanation. This seems to us essentially the right way for men of science to act; *o si sic omnes!*

RELIGION AND SCIENCE IN PRIMITIVE CULTURE

The Heathens

Primitive Man and his Religions. By William Howells. Pp. 268+16 plates. (London: Victor Gollancz, Ltd., 1949.) 18*s.* net.

IT has been sometimes remarked that there is a tendency for empirical scientists to be extremely bad at philosophy. With important exceptions, of course, the generalization may be accepted as a valid one. The architects of the modern scientific method and outlook did occasionally dabble in divine philosophy; but if their experiments in this medium constituted their only or chief claim to fame, their memory would have faded out of the modern consciousness long ago. So far as the natural sciences are concerned, this particular disability has not mattered and need not be remembered against those who suffered from it. It is churlish to complain of men who gave us so much that there was some other satisfaction which they failed to supply. An inability to think philosophically does not necessarily affect the quality of a man's scientific work, although it may render his essays in the interpretation of his results, if he is so ill-advised as to attempt any, rather sorry reading.

In the humane and natural sciences, however, philosophical incompetence is a much more serious matter, for here one's understanding of the wider significance of a social process or a human activity may determine one's way of defining it, and the definition in turn may bias, if not altogether determine, one's way of studying and presenting it. Unfortunately, philosophical incompetence is quite as common among social as among natural scientists.

The present book is a case in point. It is well informed, stimulatingly illustrated and attractively, even jauntily, written; but the total effect is misleading because of the inadequacy of the author's presuppositions, the narrowness of the frame of reference within which he locates his facts, and the comparative superficiality of the categories with which he endeavours to interpret them. For the student of primitive religion should at least have

sufficient understanding of more developed forms of religion to perceive in the former at least the implicit shape of things to come. Otherwise, although he may depict very clearly the exceeding primitiveness of the primitive, he may fail to do justice to those prophetic moments in which primitive religion points beyond itself to something which still lies far ahead. There is not, in Mr. William Howells's account of the matter, much evidence of that element of "Faith, Hope and Charity in primitive religion" of which the late R. R. Marrett once wrote so justly and persuasively.

According to Mr. Howells, religion is the complement of science, in the sense that it is an alternative way of solving problems. Religion is man trying to solve his problems without the aid of science. Since we shall no doubt always find ourselves confronted with problems which exceed our scientific powers, we shall always, in one form or another, have a religion; but the fundamental implication is that the range and extent of science and religion vary inversely.

The objections to this view, both anthropological and philosophical, are overwhelming. In the pragmatic sense of science as 'know-how'—the mastery of practical everyday techniques, which Mr. Howells himself accepts as at least adequate for anthropological purposes—primitive man has his modicum of science, but it is by no means alternative to, or exclusive of, his religion. He does not *either* bait his hook *or* recite a spell to make the fish bite. He both baits the hook and recites the spell. Frazer, indeed, taught us to regard the spell as the ancestor of the scientific formula rather than of the religious rite. No doubt he exaggerated in holding that magic belongs exclusively to the history of science and not at all to that of religion. The truth is that the two have common, or at least overlapping, origins; but Frazer's observation makes it clear that the hypothesis which supposes that religion and science are complementary and mutually exclusive processes is one that fits the facts of primitive life as inadequately as it covers those of modern life.

We have rightly rejected the intellectualism of nineteenth-century writers, like Comte and Tylor, who interpreted primitive religion exclusively as a type of belief. But we would be wise not to go too far in our reaction against this over-intellectualism. Primitive mythology certainly served other than intellectual needs, but it was nevertheless at the same time quite explicitly an attempt to account for the familiar phenomena of human life and its natural environment. The truth is that Mr. Howells seriously underestimates the importance of the intellectual element in religion, not only in his descriptions of primitive religion but also in his more rare and incidental references to modern religion. It is a discrepant fact which does not square with his hypothesis. He would have been more conscientiously empirical, more faithful to his facts, if he had been more competent in his philosophy. The intellectual element is always present in religion, submerged and muted in most primitive religion, emphasized and given a central place in the great missionary religions of historic times like Christianity and Buddhism, but always there. Normally the relations between a people's religion and its science are positive and co-operative. The conflict between the two is usually a local accident—due, in our modern experience, to an unfortunate conjunction of sincere religion, enthusiastic science and bad philosophy.

Nevertheless, because of its very readable account of a mass of interesting and important facts, the general reader who wants a good introduction to the subject is warmly recommended to sample and enjoy this book, but to treat its evaluations, definitions and interpretations with a sceptical reserve.

J. V. Langmead Casserley

LIFE ON AN ISLE OF GREECE

The Folk-Lore of Chios

By Dr. Philip P. Argenti and Prof. H. J. Rose. Vol. 1. Pp. xiv + 594. Vol. 2. Pp. xi + 595–1199. (Cambridge: At the University Press, 1949.) £7 7*s*. net.

IN these two solid volumes of 1,200 pages between them, Dr. P. P. Argenti continues his studies of Chios, this time in collaboration with Prof. H. J. Rose. His previous eight volumes in English have been mostly historical; but in the present volume the authors give a full account of the peasant life of Chios as it is lived to-day. Vol. 1, after short introductory chapters on Chios in antiquity and on medieval Chios, contains a long chapter on the occupations of men and on those of women, together with chapters on the visible world; the invisible world; birth, marriage and death; calendar customs; folk-medicine and folk tales. The second volume consists of more folk-tales; folk-songs; riddles; wishes, greetings, curses, oaths, and insults; children's games; and a brief review of the authors' conclusions. In addition to this, there are eleven appendixes on peasant dress, pastoral life, cooking recipes, proverbs relating to the weather, etc., fasts and festivals, flora, fauna and vital statistics. There are many figures in the text, a map of Chios, and a very full index.

In considering this material, the authors reach the conclusion that in spite of many changes of population, government, and religion, "the general pattern of Chios country life has not altered very much since antiquity". The population is typically Greek, and Turkish and Slavonic influences on manners, customs or beliefs has been very slight; the strongest foreign influence has been Genoese, whence come many Italian words and some enmity between the Roman and Orthodox Churches.

The folk-tales and the superstitions are on the whole European rather than oriental, though naturally a number of more or less world-wide beliefs or superstitions occur, familiar both in the West and in the East, like the ascription of toothache to the eating of the tooth by a small white worm, the systematic naming of a child after its grandparent, or the description of the Milky Way as a heavenly river. The folk-tales, of course, contain many familiar themes, but a few are apparently of local origin and limited distribution (for example, No. 47—*Yantès*). In general, they are not more eastern in character than the average corpus of folk-tales in any other European country.

The life, practices and beliefs of the Chian countryman is described in great detail. Monographs on a similar scale have often appeared on unlettered tribes; but it would be difficult to point to as full and as detailed an account of this nature of any population which is, and for generations has been, predominantly literate.

The volumes are well printed and on good thick paper; the price is very high—partly no doubt on account of the free use of the Greek character—but if anyone wishes to know the way of life in the Greek archipelago or is to visit Chios, this is the very book for them; and if they are to know the Chians, it is essential. J. H. HUTTON

ON REMOTE HEBRIDEAN ISLANDS

Island Going

To the Remoter Isles, chiefly uninhabited, off the North-West Corner of Scotland. By Robert Atkinson. Pp. 384+47 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1949.) 16s. net.

THE author of this book, regardless of hardship and discomfort, has lived on North Rona and other outlying Scottish islands, which are now uninhabited. He has done pioneering ornithological work and made valuable observations; his photographs are admirable. He has done what few naturalists have done—passed a summer night on that lonely bird-haunted rock Sùla Sgeir, forty miles north of the Butt of Lewis. Here he obtained remarkable photographs by flashlight of Leach's petrel in flight and a particularly fine photograph of the gannet colony on the rock.

Mr. Atkinson has observed the guillemots and puffins on the Flannans and has made more than one arduous voyage to St. Kilda to photograph the St. Kilda wren, of which his photographs are perhaps the best in existence. Here is the material for an outstanding book, and yet the author has just failed to write it. He writes on occasion vividly enough, but indulges overmuch in mimicry of Hebrideans, their ways, and their English. Yet his own prose is by no means above reproach, and when reading I have sometimes found myself wondering what he really means. He writes, for example, of the engine of his boat "beating its oily guts"; he likes to speak of the "unwarm" air. His descriptions, too, of birds are sometimes strange. Thus, on p. 38 he writes of "Boar and Sow Guillemot" and, on p. 176, of "gross and squaking terns".

Yet there is much of value in the book, and the author has been at considerable pains to collect, and often to quote, an exhaustive bibliography on the little-known islands he has visited. He estimates (p. 70) that there is a nesting colony of 380 pairs of Leach's petrel on North Rona, and writes of the great slaughter on that island of puffins, kittiwakes and other sea birds by greater black-backed gulls. On p. 84 he records the strange fact that the egg of Leach's petrel may be left unincubated for several days, and yet it apparently hatches out successfully. He is right in saying that the stormy petrels, and not the terns, merit the name "sea swallows". Their swallow-like flight is apparent to all who have studied them. Leach's fork-tailed petrel is rather larger than the common stormy petrel, and is not so late in laying its eggs. It is found on very few islands—St. Kilda group, North Rona, Sùla Sgeir and the Flannans—and Mr. Atkinson has studied them at all these places with great enthusiasm.

He has something to say of the killing of the young gannets on Sùla Sgeir for food. This harvesting of the young birds was at one time usual at most of their breeding rocks. They were taken on the Bass, Ailsa Craig, the St. Kilda stacks and on Sùla Sgeir. They are now taken only on one rock, namely, Sùla Sgeir, where the fledglings are known as *gugas*. It was news to me that, besides being eaten with relish on Lewis (the crew of the boat making the expedition sails from Port of Ness in Lewis), they are salted and dressed and sent by post to Lewismen throughout the world.

Besides his visits to outlying isles, the author stayed on the Inner Hebridean island of Eigg, to study the shearwaters there; his visit to Canna for the same purpose was without success. But his first love is North Rona, and it is evident that he is most happy when he is ashore on that island. He records the crash-landing of an aeroplane there during the Second World War. I recall hearing of this at the time, and wondering how it had been possible to rescue the crew on an isle continually pounded in winter by heavy seas—that was before the time when helicopters were used for rescue work.

It is, by the way (p. 178), the cry of the great northern diver and not the red-throated diver that is said to foretell winds and rain. SETON GORDON

PRINCIPLES OF SOIL IRRIGATION

Irrigated Soils

Their Fertility and Management. By Prof. D. W. Thorne and Prof. H. B. Peterson. Pp. ix+288. (Philadelphia and Toronto: The Blakiston Company, 1949.) 5 dollars.

THERE are probably between 250 to 300 million acres under irrigated agriculture in the world, China, India and Pakistan accounting for about half the total. Plans for bringing another forty to fifty million acres under irrigation, including twenty-five million in India and Pakistan, have been projected. This huge area includes much of the most productive land in the world. It is estimated that more than half the population of the world depends on food grown under irrigation; but, in spite of the great and growing importance of irrigation for food production, very few authoritative text-books on irrigated agriculture have appeared.

The book here under review is an extremely valuable addition to the literature. It deals, as its title indicates, with irrigated soils; but all the unique characteristics of irrigated agriculture derive from the application of water to the soil and the high degree of control that can thereby be obtained over the effective climate for plant growth. Treatment of the subject is comprehensive, and includes a short account of the history and present extent of irrigation, the nature and problems of arid soils, soil and water in relation to plant growth, the quality, measurement and application of irrigation water, drainage, and the management and manuring of the land under all the important irrigated crops. The conditions described are those of the United States, and most of the research work cited is American; but such a wide range of irrigated conditions from extreme aridity to sub-humidity is found, and so much thorough research has been done, in the United States that the great store of information provided will be applicable everywhere that irrigation is practised.

The authors begin by describing and explaining the basic principles which underlie soil-management practices, and then illustrate the application of the principles to the solution of the many problems that arise from irrigation. For the soil chemist and

physicist, the chief problems concern the accumulation of salts and lime, and high alkalinity with its deleterious effects on soil structure. Great progress has recently been made towards their solution, while other, and in many respects more difficult, plant-physiological problems associated with osmotic-stress values resulting from abnormally high salt concentrations in the soil solution are attracting increasing attention.

Soil-moisture relationships assume particular importance under irrigated agriculture, and have not been made easier for the layman to understand by the modern and very fruitful concept of using energy relations to characterize soil-moisture phenomena. The authors' achievement in explaining these phenomena simply and clearly, but adequately, is one of the best things in the book, which is almost certain to become a standard text-book on the subject.

PANORAMA OF BRITAIN'S ECONOMY

A Concise Economic History of Britain

From the Earliest Times to 1750. By Sir John Clapham. Pp. xvii+324. (Cambridge: At the University Press, 1949.) 12*s.* 6*d.* net.

OF all aspects of history, the economic, though not the most important, is the most fundamental, because it is concerned with the story of man's work, particularly in agriculture, trade and manufacture. It is concerned more with the ordinary man and the routine affairs of everyday life than with the lives of great men or the high spots of diplomacy, strategy or politics. Thus to the economic historian "the Norman Conquest is not so decisive an episode as it rightly seems to the general historian. It made no change in the economic resources of Britain or in its economic position in western Europe, and did not at once link it any more closely with other regions. The growing intimacy with the outer world that we notice after 1066 might have come in any event" (p. 69).

Economic activity is likened by Sir John Clapham to the basement of man's house. In the course of ages this basement has provided, first for the privileged few and then for more, the opportunity to practise higher things. In a masterly survey the author examines this basement throughout the centuries, and has produced a most readable account, without sacrifice of accuracy and without entering into those incautious generalizations which are so dangerous a pitfall in the path of anyone writing a concise history. In broad majestic sweeps, spanning the centuries, he writes of villages and hamlets, of crafts and craftsmen, of gardens and orchards, of agriculture, industry and finance, of windmills and watermills, of merchants, apprentices and yeomen, and of turnips, clover and potatoes. Occasionally he spares time to pause so that we may make the acquaintance of some individual hitherto unknown to fame, as Odo the Catapult Man or Otho the Goldsmith. Or again, when illustrating the opportunities which were open to an able thirteenth-century merchant, we are given a thumb-nail biography of William of Doncaster, citizen of Chester in the reign of Edward I. William had agents who bought wine in Gascony which he re-sold to the Court and the public, he sent wool over to Ipswich for the Flanders market, he traded with Ireland in corn, and he once did a big deal with the king in horseshoes and nails. As all successful traders did for centuries, he invested part of his fortune in land.

Sir John Clapham lectured during 1908–35 in the University of Cambridge on British economic history; but he died before this book went through the press. Mr. John Saltmarsh, one of Clapham's former pupils, has prepared the text for the printers, and is to be congratulated on the excellent way he has carried out this task. This scholarly work, brilliantly written, and a marvel of condensation, is a fitting complement to the massive volumes of the author's "Economic History of Modern Britain". K. G. FENELON

APPLIED ACOUSTICS

Traité de prise de son

Par José Bernhart. (Collection de la radiodiffusion française.) Pp. 382. (Paris: Éditions Eyrolles, 1949.) 2,950 francs.

THIS book, on the use of the microphone in all forms of sound recording in the studio and the open air, is prefaced by the composer Arthur Honegger, who rightly says that the musician will here find, coded in scientific formulæ, results of acoustic science which he himself could only attain after a long hit-or-miss experience. The work is, in fact, addressed rather to the 'producer' and 'director' than to the technologist, though the data are presented in an imposing array of tables and graphs built on a truly scientific background of experiment. As the author points out, the *métier* of sound engineer unites art and technique. One feels as one reads that he, as head of the sound engineering department of Radio Diffusion Française, certainly knows what he is writing about.

There is, in fact, no other text in which can be found the fruits of so varied an experience in all forms of sound pick-up, covering as it does auditorium and studio acoustics, broadcasting, the film, directive properties of typical microphones, and stereophonic reproduction. Later sections deal with the properties of the ear and the possible distortions introduced by electro-acoustic systems, the directional properties of orchestral instruments in relation to the microphone, first as solo instruments and then in small ensembles, and finally the best microphone grouping for balance of power in recording a large orchestra. Then we have the sound montage for recording a single speaker or a complete drama; even how to produce 'noises off'. Nothing, in fact, escapes M. José Bernhart's all-embracing pen, whether it is the technique of 'mixing', of dynamic balance or of 'compression'. Finally, he suggests a course of training in critical listening and score-reading suitable for young technicians. Certainly an aspirant in this profession who had absorbed all the matter of this book could congratulate himself that only experience was required to make him expert.

The effect on the general reader of this mass of information is at first overwhelming, but a closer study will reveal that there is, in fact, some repetition, apparently in the attempt to make each section self-contained. Set down in simplest musical and scientific terms, the whole could probably have been condensed to half its space. Nevertheless, M. Bernhart holds the reader's interest to the end, ably seconded by his draughtsman and photographer. There are extensive bibliographies. E. G. RICHARDSON

The Works of George Berkeley, Bishop of Cloyne

Edited by Prof. A. A. Luce and Prof. T. E. Jessop. (Bibliotheca Britannica Philosophica.) Vol. 2: The Principles of Human Knowledge; First Draft of the Introduction to the Principles; Three Dialogues between Hylas and Philonous; Philosophical Correspondence with Johnson. Edited by Prof. T. E. Jessop. Pp. vii+294. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1949.) 30*s*. net.

THE second volume in this admirable new edition of Berkeley (see *Nature*, October 15, 1949, p. 634) contains his most important philosophical works: the "Principles", the most systematic exposition; and the "Three Dialogues", more popular and one of the best essays in philosophical dialogue since Plato. Berkeley's "First Draft of the Introduction to the Principles" is placed very suitably in this volume, for comparison with the final version, rather than tucked away among minor writings in later volumes. The "Introduction", of course, is not the usual sort, but contains an important part of his argument. The letters at the end of the volume are disappointing, in the sense that Berkeley's American friend, Samuel Johnson, extracted no fresh arguments in reply to objections. For the most part, Johnson is referred to work already published. However, the letters do show that, twenty years after the first edition of the "Principles", Berkeley was satisfied that he had no fresh arguments.

Prof. T. E. Jessop considers that the "De Motu", "The Analyst" and "Alciphron" contain substantially the missing three parts that Berkeley had in mind when he published the "Principles" as Part 1. This removes the suspicion that something has been lost —a suspicion roused by Berkeley's remark that he had lost MSS. on his travels and was unwilling to rewrite. For all its brilliance, penetration and close reasoning, Berkeley's work is disappointingly negative. We know exactly what he objected to; we know far less of what he adhered to. As Prof. Jessop says, he wrote as a controversialist, refuting "corporeal" or "minute" philosophers, or else meeting objections to his own statements. Those of us who come from east of St. George's Channel assume that controversy is natural to every Irishman, but we cannot help regretting that their greatest philosopher ran so true to type.

A. D. RITCHIE

Simple Organic Practice

By H. Middleton. Pp. viii+172. (London: Edward Arnold and Co., 1949.) 7*s*. 6*d*.

MANY teachers of organic chemistry, indebted to H. Middleton for his safe and reliable test for nitrogen, will examine his latest practical book with more than usual interest—and will not be disappointed. Space precludes details of the contents, but Middleton describes: the preparation and properties of about eighty simple compounds—including such a novelty as adipic acid of nylon fame; the determination of physical constants; and a systematic scheme for the identification of simple organic compounds.

The author is obviously a skilful chemist and experienced teacher. He knows the limitations of the laboratory and of student's time and other difficulties. He himself has made first-hand acquaintance with all the procedures and preparations he describes. Thus, while he wisely omits preparations which take up a disproportionate amount of time, he makes many others on a small scale. The subject-matter is clearly set out in paragraphs and sections with bold headlines; this is especially helpful to a student using the scheme of analysis. The reviewer ventures to suggest that Middleton should, in the preparation of oxalic acid, replace sucrose by glycol, as being more instructional and also expressible by an equation.

This book of undoubted worth is sold at a very reasonable price, and all students and teachers of organic chemistry should make themselves acquainted with it.

G. F.

Birds in Action

By Eric Hosking and Cyril Newberry. Pp. 128 (69 plates). London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1949.) 16*s*. net.

THE advent of the high-speed electronic flash-lamp, with its application to photography, has placed new power in the hands of the ornithologist with a camera. For many years it seemed as if bird photography could go little further. So far as the British Isles were concerned, most of the breeding species had been photographed again and again. Bird photographers sighed for fresh subjects, or at any rate new aspects of old ones, and sighed in vain until the coming of this high-speed apparatus. "The flash can be made as short as 1 micro-second, that is, a millionth of a second, but in practice is usually arranged to last about 1/10,000th second."

This is a quotation from "Birds in Action", a volume of pictures with descriptions by Eric Hosking and Cyril Newberry, illustrating the results obtained by them when using the electronic flash in the photography of birds.

Whereas, in days gone by, movement was the bugbear of the photographer, we here see it as his delight. Birds in flight, birds in every sort of swift action, are portrayed in crispest detail without blur or distortion. For the details of this collection of remarkable and beautiful pictures, the reader must be referred to the book itself, where he will also find a description of the apparatus employed to obtain them.

FRANCES PITT

Wild Flowers at a Glance

By M. C. Carey and Dorothy Fitchew. Pp. xi+275. (London: J. M. Dent and Sons, Ltd., 1949.) 10*s*. 6*d*. net.

THIS is one of the very few flower books that aid recognition in a non-botanical way which we would recommend. Here 264 flowers are portrayed in colour, and are grouped according to colour of flower—five groups in all, namely: white; greenish-white, green or greenish-yellow; yellow; blue; red, shades of pink or purple.

All the illustrations have been prepared by Miss Dorothy Fitchew, and are accurate reproductions from actual specimens. Within each colour group, the flowers are arranged according to family. Each floral picture appears on a separate page, which also carries the common and botanical names, name of family, habitat, time of flowering, height of plant, a general description of the whole plant and its parts, and finally the derivation of generic and specific names.

A beginner will find this a most useful aid with his field work, and probably having had no formal botanical training beforehand, will soon find his interest sufficiently aroused to delve more deeply into the science of botany.

THE BRITISH NATIONAL COPIES OF THE METRE AND THE KILOGRAMME

By F. A. GOULD and J. S. CLARK
National Physical Laboratory

THE British national copies of the International Prototype Metre and Kilogramme belong to a series of similar standards which were issued, in 1889, by the Bureau International des Poids et Mesures to countries subscribing to the International Metric Convention of 1875. The British copies were originally deposited with the Standards Department of the Board of Trade, but were eventually transferred to the responsibility of the Department of Scientific and Industrial Research, and placed in the custody of the National Physical Laboratory. The copies were verified at the Bureau before their issue to Great Britain. Their re-verification is one of the duties of the Bureau and is carried out on request. The copies, duly corrected for errors determined in such re-verifications, serve as the basis of determination of the metric units of length and mass in Great Britain. Provision is therefore made for other reference standards used in the general scheme of maintenance of these units to be compared at suitable intervals with the copies. Standards of appropriate status are kept at the Board of Trade Standards Department and at the National Physical Laboratory; and it is the duty of the National Physical Laboratory to make comparisons of these standards both among themselves and with the national copies.

The International Prototype Metre is a bar of platinum–iridium alloy of a special X-form section devised by Tresca to give maximum rigidity in relation to the weight of alloy used. The metre is the distance between two transverse graduation lines on the exposed neutral plane of the bar near its ends, when the bar is appropriately supported and at the temperature of 0° C. The British copy of the metre is generally similar to the prototype, although its defining lines are slightly inferior in quality. The thickness of each of the lines on the British copy is about 8 μ.

The copy has been compared with the International Prototype on one occasion only since 1889, namely, in 1922, but it has recently (November 1949) been compared at the Bureau with two reference standards there, both of which had been compared with the International Prototype in 1939. The three values obtained at the Bureau were in agreement to within one part in 10^7. Evidence of the relative stability of the family of platinum–iridium metres has been obtained from work, commenced thirty years ago, in which twenty-seven members were intercompared at the Bureau. The results for individual metres were all in agreement to within $\pm$ 1 part in 10^6 with the original determinations made before 1889, the mean of all the results agreeing with the original mean to within 1 part in 10^7. Indeed, all but three of these metres were within five parts in 10^7 of their original values, and one of these three was known to have been damaged in the meantime. Confirmation of this internal evidence of good stability has been obtained from extensions of this work to all members of the family.

The National Physical Laboratory has recently completed three series of intercomparisons of four one-metre standards of length, including the British national copy, one standard belonging to the Board of Trade Standards Department, and two belonging to the Laboratory itself. The results show that the standards concerned have varied from their mean lengths in terms of the accepted length of the national copy by $\pm$ 3 parts in 10^7 since 1902. The materials with which these various standards are made (platinum–iridium, pure nickel, fused silica) are considered to be stable, and when it is stated that a particular standard appears to have changed its length, it might be more accurate to say that the interpretation of the position of the defining lines has changed. The lines on the various standards are by no means all equally good—in fact, the lines on the British copy are rather inferior to those on some of the more modern standards of the National Physical Laboratory. The so-called lines are really narrow grooves of various widths having dissimilar edges in some cases, and their apparent positions under the micrometer microscopes of the comparator are subject to varying interpretations by different observers under different conditions of illumination and observation. This possibility may apply also to the national copies of the metre, and it is probably fair to say that it is impossible to state with certainty the length of any one-metre line standard of conventional design, and made more than twenty-five years ago, to an accuracy better than $\pm$ 2 parts in 10^7; 2 parts in 10^7 is therefore the limiting precision of length measurement attainable on this basis. In recent years the Bureau has had some of its own working standard metres re-polished and re-ruled, and it may ultimately prove possible, when line standards are provided with graduation lines of the superior quality now attainable, to improve the accuracy of determination to about 1 part in 10^7.

The British copy of the kilogramme takes the form of a simple cylinder, of height equal to its diameter, and is made of the same platinum–iridium alloy as the International Prototype which defines the kilogramme mass. Four determinations of the mass of the British copy have been made by the Bureau during the period 1889–1948. These were all in close agreement and showed no difference exceeding 0·02 mgm., that is, 2 parts in 10^8. The latest value is in almost exact agreement with the original value in 1889.

The stability of the family of copies of the Kilogramme has been well established. Many of the copies have been re-verified several times by the Bureau. Of these, only a small minority have exhibited changes exceeding 0·02 mgm., the maximum being 0·05 mgm. The International Prototype Kilogramme itself was included in comparisons made in 1939 and 1946, and its high stability in relation to other members of the family was closely established.

It is emphasized by the Bureau that such high stability is not to be expected unless the surface of the Kilogramme is suitably conditioned. The Bureau applies a process of surface conditioning by steaming designated as 'lavage'. This was used before the initial determination of each national copy and is now applied on each occasion of re-verification. The latest re-verification of the British copy provided a striking example of the need for surface conditioning.

This copy had not been used for any weighings between 1933 and 1947, but when weighings were made in the latter year, its mass before surface conditioning was found to exceed the expected value by several hundredths of a milligramme. This excess was attributed to the growth on its surface of an invisible film which was removed by the cleaning at the Bureau.

In making comparisons between the British copy and other kilogrammes of appropriate status available in Great Britain, the National Physical Laboratory was fortunate in being able to include with these the Australian copy of the Kilogramme, newly issued by the Bureau in 1947. The difference between the British and Australian copies found at the National Physical Laboratory was within 0·004 mgm. of the difference between the Bureau's certified values for these kilogrammes. The remaining two kilogrammes which were included in the comparisons at the National Physical Laboratory have shown changes in mass of the order 0·03 mgm. since 1933. These were not unexpected in view of the history of these kilogrammes and the fact that they are used more frequently than the British copy.

The improved equipment and technique employed at the National Physical Laboratory have enabled the interconsistency of the kilogrammes to be examined more closely than hitherto. Apart from the effect of surface cleaning, it appears from an analysis of the weighings made during 1947–49 that the changes which occurred in the kilogrammes during that period were of an appreciably higher order than the error of weighing of about ± 0·001 mgm. associated with the precision balance used at the Laboratory. Such changes may arise from physical or chemical action at the surfaces of the kilogrammes, or from wear due to abrasion. The British copy is normally only used sparingly, for example, at intervals of ten years or more for the specific purpose of re-verifying the principal reference standards which serve for the maintenance of an accurate standard of mass in Great Britain.

The above review has been prepared as part of the research programme of the National Physical Laboratory, and is published by permission of the Director of the Laboratory.

FURTHER OBSERVATIONS ON ABSORPTION SPECTRA AT LOW TEMPERATURES

By Prof. D. KEILIN, F.R.S., and Dr. E. F. HARTREE
Molteno Institute, University of Cambridge

In a previous contribution to *Nature*, we described the effect of liquid-air temperature on the absorption spectra of hæmatin pigments such as cytochrome, catalase, peroxidase and different derivatives of hæmoglobin, as well as on the absorption spectrum of didymium salts[1]. We showed that the visual strengthening of the absorption bands arose from two independent phenomena: the already known sharpening of bands at low temperatures which is an intramolecular process, and a very marked intensification which is dependent upon the crystallization of the aqueous solvent.

After demonstrating our main observations at Cambridge during the First International Congress of Biochemistry, we came to the conclusion that it would be worth while to record photographically some of the phenomena thus observed and to bring forward additional evidence which would clarify certain points of our interpretation.

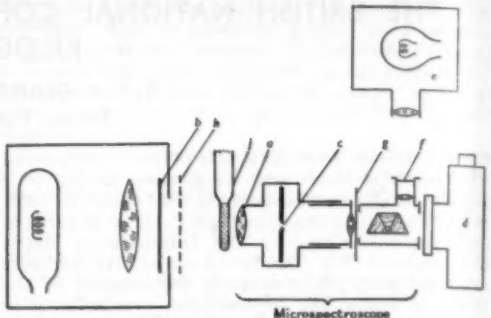

Fig. 1. Apparatus for spectrum photography. *a*, Lower lens of microspectroscope; *b*, heat filter; *c*, spectroscope slit; *d*, Leica camera; *e*, microscope lamp; *f*, wave-length scale; *g*, light filter; *h*, ground-glass filter; *j*, flattened tube holding specimen

Intensification of Bands due to Multiple Reflexions within a Devitrified Frozen Solvent

The intensification of absorption bands at low temperatures that follows crystallization or devitrification of the solvent, in the case of water and aqueous glycerol respectively, was ascribed by us to multiple reflexions within the micro-crystalline mass of solvent which increases the effective optical depth of the pigment. Since, however, it is difficult to realize the magnitude of these changes from a verbal description, we are now reproducing a few photographic records which were obtained in the following way (see Fig. 1).

The lower tubular extension of a microspectroscope ocular was unscrewed to expose the lens (*a*) situated beneath the slit. The spectroscope was then clamped

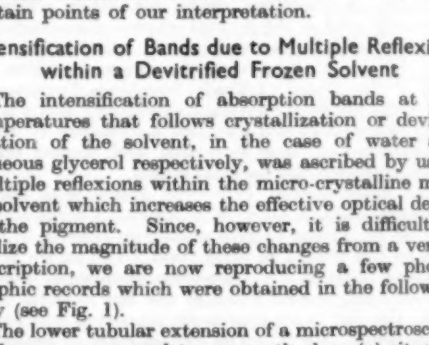

Fig. 2. Absorption spectra of didymium nitrate in 50 per cent v/v aqueous glycerol showing intensification obtainable at liquid-air temperature. Ilford *H.P.*3 film; Ilford filters 802+803; ground-glass filter (for *a* and *b* only). Exposure times: 0·1 sec. for *a* and *b*; 20 sec. for *c*.
a, 25 per cent w/v didymium nitrate; *b*, 1·25 per cent didymium nitrate frozen to a glass in liquid air; *c*, as *b*, after warming to devitrification point and re-cooling in liquid air

in a horizontal position and light from a 250-watt projector lamp, passing through a heat filter (*b*), was brought to a focus approximately on the slit (*c*). A Leica camera (*d*), fitted with a ground-glass viewing screen, was fixed as close as possible to the prism of the microspectroscope ocular, and the spectrum image focused on the screen. By means of a second lamp (*e*), an image of the wave-length scale (*f*) was also focused on the ground-glass screen. Light filters (*g*) and in certain cases a translucent filter of ground-glass (*h*) were interposed as shown in Fig. 1. The substance used in these experiments was didymium nitrate (technical), solutions of which were contained in a 'Pyrex' glass tube (*j*), 12 mm. in diameter, the end of which had been blown to a flattened disk-shaped cell about 25 mm. in diameter with an optical depth of 4 mm. The cell when filled with solution was placed in front of the lower exposed lens of the microspectroscope ocular. The film was developed in *DK*20 developer and printed on high-contrast paper.

Fig. 2 illustrates the magnitude of the intensification of absorption bands of didymium nitrate dissolved in 50 per cent glycerol (v/v). Spectrum *a* is that of 25 per cent didymium nitrate, while *b* is that of 1·25 per cent didymium nitrate in the form of a transparent glass obtained by rapid cooling in liquid air. Cooling under such conditions leads to a slight sharpening of the bands which, although very distinct on direct visual observations, cannot be clearly recorded by the present photographic method. Thus for all practical purposes *b* also represents the absorption spectrum of the 1·25 per cent solution at room temperature. The aqueous-glycerol glass was allowed to warm until it devitrified, when it passes through an amber-coloured translucent stage to a white crystalline mass, which was rapidly re-cooled in liquid air. The spectrum *c* was obtained immediately after removing the devitrified sample from liquid air. Since the absorption bands in *a* and *c* are of the same order of magnitude, it follows that an intensification of about twenty-fold has been obtained. The photographs also show that at low temperatures the bands are slightly shifted towards the blue, but the accompanying fine structure can only be appreciated on direct visual spectroscopic examination. It may be mentioned here that, in absence of light filters, in addition to the absorption bands shown in the above photographs it was possible to obtain records of bands lying at lower wave-lengths. However, under such conditions the over-exposure gives a false picture of the bands in the longer wave-length region of the spectrum.

The marked amber colour by transmitted light that is apparent at the onset of devitrification even in absence of pigment is undoubtedly due to light scattering, since a distinct blue colour can be observed by reflected light at the devitrification zone as it moves through the colourless glass-like material.

Intensification of Bands due to Multiple Reflexions at Room Temperature

As we have previously shown[1], a similar though less marked intensification of bands was obtained by adding sufficient kieselguhr to a thin layer of didymium nitrate solution to form a solid cake. It was suggested to us that such intensifications might find an alternative explanation in terms of an orientation of pigment molecules on the diatom surfaces, or at the crystal faces in the case of a devitrified cooled solvent. The fact that the degree of intensification is dependent upon the state and composition of the solvent but not upon the absorbing solute makes such an explanation very unlikely. However, the following experiment clearly demonstrates that it is unnecessary to assume any physical association of solute and solvent in order to explain our observations.

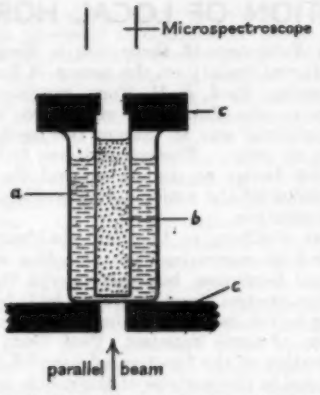

Fig. 3. Absorption of scattered light. For explanation, see text. *a*, Tube containing pigment solution; *b*, tube containing water or kieselguhr suspension; *c*, light baffles

A flat-bottomed tube 7 mm. in diameter and 55 mm. high (*b*, Fig. 3) was held concentrically within a wider 18-mm. diameter tube (*a*) by means of a collar of polyvinyl chloride sheet (*c*) or other opaque material. For half its thickness the internal diameter of the collar was slightly smaller than that of the narrower tube, so that the latter could pass only half-way through the collar. Beneath the tubes and on the stage of the microspectroscope outfit[2,3] was placed a suitably drilled piece of the same sheet, which together with the collar ensured that only the light passing through the liquid in tube *b* reached the microspectroscope. If *a* contains a pigment solution and *b* is filled with water, then naturally no absorption bands of the pigment can be observed in the microspectroscope. However, if a little kieselguhr is suspended in the water in *b*, the absorption spectrum of the pigment can be clearly observed. Light scattered from the kieselguhr and passing into the pigment solution is reflected back from the wall of the wider tube and scattered again within the tube *b* so that it reaches the microspectroscope. This experiment indicates that repeated reflexions from suspended solid particles can give rise to an absorption spectrum even when there is no direct association of the pigment with the particles.

An increase in the effective optical depth due to multiple reflexions is therefore the only obvious explanation of the very marked intensifications of absorption spectra on devitrification which can be observed when the solvent changes from a glass to a crystalline mass, as is the case with aqueous glycerol. Similar though less striking intensifications may be obtained with water as the solvent. Such variation in the degree of reinforcement of the bands must be due to differences in the crystalline structure of the frozen material.

We wish to express our thanks to Dr. R. Markham, who photographed the spectra.

[1] Keilin, D., and Hartree, E. F., *Nature*, **164**, 254 (1949).
[2] Keilin, D., and Mann, T., *Nature*, **148**, 493 (1941).
[3] Keilin, D., and Wang, Y. L., *Biochem. J.*, **40**, 855 (1946).

ACTION OF LOCAL HORMONES

ON February 16 there was a discussion at the Royal Society on the action of local hormones. In opening, Prof. J. H. Burn, professor of pharmacology in the University of Oxford, said that the first proposal was to discuss the mechanism of the action of drugs. This subject was too wide, and it was felt better to discuss instead the more recent knowledge of the action of adrenaline, acetylcholine and histamine.

Both Feldberg in 1930 and Gaddum in 1936 had referred to adrenaline, acetylcholine and histamine as local hormones, but the concept that these substances control local activity had been forgotten owing to the importance they had acquired as transmitters of nerve impulses. Prof. Burn then gave an illustration of the function of acetylcholine as a local hormone in the auricles of the rabbit heart. He said that evidence has been obtained that acetylcholine not only inhibits the auricles, but also in some circumstances stimulates them. Thus, when auricles are exposed to 'Paludrine', after a time they cease to beat, but can be started again by acetylcholine. Similarly, if the auricles are allowed to beat for 24 hr. or more until they stop, the beat can be started by acetylcholine. These observations led to a study of the synthesis of acetylcholine by an acetone powder prepared from auricles. Feldberg and Mann worked out a method for studying the synthesis in brain, and Comline, using this method, found synthesis to occur in auricles. The acetone powder was incubated with choline and citrate in the presence of adenosine triphosphate and other substances. A comparison was made by Dr. Edith Bülbring between powder from freshly excised auricles, powder from auricles which had stopped beating in 24 hr., and powder from auricles in which the beat was started again by acetylcholine. It was found that the stopped auricles had lost most of the synthetic power of the fresh auricles, but that the re-started auricles had regained it. Further, it was found that just as acetylcholine depresses the contractions of fresh auricles in a bath, so the addition of acetylcholine to tubes containing powder from fresh auricles depresses the synthesis in proportion to the amount added. More surprising was the observation that the addition of acetylcholine to tubes containing powder from stopped auricles increases the synthesis in proportion to the amount added, exerting an autocatalytic effect. This again is parallel to the action of acetylcholine in stimulating the contraction of stopped auricles in the bath. Thus there is at all stages an extremely close parallelism between the size of the contractions and the power to synthesize acetylcholine. To explain the function of acetylcholine in relation to the contractions, Prof. Burn suggested that its role is similar to its function in skeletal muscle, where the motor nerve liberates acetylcholine to cause the contraction. In cardiac muscle, acetylcholine seems to be continuously synthesized and then liberated to maintain the rhythmicity. This is its function as a local hormone.

The action of acetylcholine in the blood vessels was then discussed, since it has certain points of similarity to the action in the auricles.

Dr. W. Feldberg, of the National Institute for Medical Research, spoke on the origin and function of the acetylcholine in the intestinal wall, where acetylcholine is continually produced and liberated. The nerve cells have been thought to produce it, but various pieces of evidence now indicate that this is not so. In the perfused superior cervical ganglion, the liberation of acetylcholine by preganglionic stimulation is prevented by cocaine; but in the intestine, cocaine, even in high concentration, does not prevent the liberation.

The synthesis of acetylcholine by different parts of the intestinal wall, glandularis mucosa, muscularis mucosa, submucous coat and the external muscular coats has been carefully investigated, and it has been found that the distribution of the synthesizing enzyme bears no relation to the localization of the nerve cells. These facts suggest that the acetylcholine production is not nervous in origin.

If acetylcholine is produced in non-nervous tissue, what is its function? Dr. Feldberg suggested that, in the first place, by its action on smooth muscle fibres, the released acetylcholine will increase muscle tone and motility and so facilitate the peristaltic reflex. In the second place, by its action on the gland cells, it will stimulate the secretion of succus entericus; it may also influence absorption. In the third place, acetylcholine may stimulate the nerve cells so as to keep them in a continuous state of tonic activity, or in such a way as to lower their threshold to other stimuli. Ambache has published experiments which on analysis indicate that 5–20 per cent of the effect of acetylcholine on the small intestine results from ganglionic stimulation. Dr. Feldberg thought that if such a mechanism exists in the wall of the intestine, it may also exist in the central nervous system.

A later contribution to the discussion by Prof. R. H. S. Thompson, professor of chemical pathology in Guy's Hospital Medical School, London, may be suitably considered here. An investigation of the distribution of the two main types of mammalian cholinesterase, called by Mendel "true" and "pseudo", has revealed a suggestive contrast in their distribution in different tissues. Both enzymes destroy acetylcholine; true cholinesterase will also split acetyl-β-methylcholine but not benzoylcholine, whereas pseudocholinesterase will split benzoylcholine but not acetyl-β-methylcholine. Prof. Thompson said that in brain, in skeletal muscle and in the suprarenal gland, the enzyme present has been found to be predominantly true cholinesterase; in stomach, liver, lung and salivary gland the amounts of the two enzymes are similar; finally, in the auricle and ventricle of the heart, in the intestinal muscle and mucosa, and in Harderian gland and skin, the pseudocholinesterase is present in much greater amount than the "true". In the human placenta, after perfusion to remove red cells and plasma, the true cholinesterase predominates. Since the placenta is free from nervous tissue, it is clear that true cholinesterase is not specifically associated with nervous activity.

Prof. J. H. Gaddum, professor of pharmacology in the University of Edinburgh, discussed the identity of the substances liberated by sympathetic stimulation and their actions. He pointed out that the primary amine *nor*adrenaline is present, with adrenaline, in extracts of adrenal glands or adrenal medullary tumours. Both substances are liberated from the adrenals by stimulation of the splanchnic nerves. Extracts of adrenergic nerves also contain both substances, and a mixture is liberated when these nerves are stimulated. In extracts of splenic nerves and in blood collected from the splenic vein during stimulation of these nerves, there is at least ten times more *nor*adrenaline than adrenaline. The

factors controlling the percentage of methylation are not yet fully elucidated.

Most of the actions of these two drugs are qualitatively the same but quantitatively different. Barger and Dale divided effects into excitor effects and inhibitor effects. In the light of recent evidence (Konzett, West, Ahlquist) this classification must now be modified. Various excitor effects and the inhibitor effect on the intestine may be classed together as α-effects, and various inhibitor effects and the quickening of the heart may be classed as β-effects. Like other antagonists, ergotoxine in small doses may cause sensitization. Local hormones may also have opposed effects in different doses. Inhibitory effects after large doses may be comparable with a similar effect of some substrate on enzymes, or with adaptation of sense organs, or with accommodation in excitable tissues, or it may be associated with more or less continuous depolarization of surfaces.

Prof. R. A. Peters, Whitley professor of biochemistry in the University of Oxford, described work which has been done on fluoroacetate poisoning. Following on observations *in vitro* with kidney homogenates, determinations of citrate have been made in various organs of the rat after injections of fluoroacetate which induced convulsions. Within an hour, very high accumulations of citrate were found, which can be explained in terms of the tricarboxylic acid cycle. It is clearly possible, he said, that fluoroacetate can be activated like acetate and built in to form a fluoro-6-carbon acid which may be too foreign for further metabolism. There is reason to think that the block is at the stage of *iso*citric acid oxidation, and that it is induced by the inhibitory action of a fluoro-6-carbon acid. The accumulation of citric acid has been established by its isolation. Prof. Peters suggested that increases and decreases of citrate formed in tissue cells may be one of the regulators of ionic calcium activity. Bronk and his colleagues have shown the effects of sodium citrate in increasing the excitability of nerve, and thus the occurrence of convulsions after injection of fluoroacetate may be explained. It has been possible to show, by examining the brachial and sacral plexus twelve hours after injecting fluoroacetate, that citrate can accumulate in frog's nerve. Normal activity may therefore be controlled in part by the interaction of ionic calcium with citrate produced by the tricarboxylic acid cycle.

Prof. G. L. Brown, Jodrell professor of physiology at University College, University of London, reviewed the action of acetylcholine and adrenaline in striped muscle in order to consider whether their excitatory and inhibitory effects in cardiac and smooth muscle can be similarly explained. When acetylcholine is applied to the end plate of skeletal muscle, it generates a potential which starts the propagated excitation wave. If acetylcholine persists in the presence of an anticholinesterase, there is prolonged depolarization and repetitive firing of the muscle fibre. Persistence of high concentrations at the mammalian end plate can produce neuromuscular block due to depolarization which does not evoke propagated contractions, but a localized contracture which blocks conduction along the muscle fibre. In smooth muscle, acetylcholine does appear to act by depolarizing some sensitive region and initiating a contractile process.

Is it possible to explain the vagal inhibition of the heart as due to excess of acetylcholine? Gaskell found that when the potential difference between the middle of the tortoise auricle and the damaged end was measured, vagus stimulation increased the resting potential. Hence the direction of the effect was the opposite of what would be expected if conduction block were produced by depolarization in a conducting pathway.

Adrenaline has two actions on skeletal muscle, namely, a decurarizing action at the neuromuscular junction and a direct action on the contractile process whereby an increase in muscle tension is associated with a retardation of the spread of the action potential and an increase in the resting potential. In smooth muscle, adrenaline acts very like acetylcholine in skeletal muscle. On the nictitating membrane, adrenaline produces a local depolarization from which arise in turn propagated muscle responses with action-potential spikes. Injected adrenaline, again, can produce a local non-propagated depolarization and a contracture which prevents the propagation of excitation arising from incident nerve volleys. Adrenaline must be regarded as an agent capable of evoking local potentials at the sensitive regions of the structure concerned.

The action of adrenaline on the heart seems to have no connexion with its action in skeletal muscle. There is no satisfactory evidence that the inhibitory actions of adrenaline are due to the accumulation of a substance which in lower concentration is excitatory. Bozler's recent work suggests that the inhibitory actions of adrenaline on the gastro-intestinal tract may eventually be correlated with its actions in skeletal muscle.

Prof. Z. M. Bacq, of Liège, considered that it is important to know what physiological function a substance found in the body exerts before it is called a hormone. Thus pure adrenaline is present in the parotoid glands of toads, but its function is unknown. He pointed out that acetylcholine has other functions besides those of a transmitter of nerve impulses, since in crustaceans it plays no part in the synapse, though it protects the ganglion against strychnine poisoning. Further, he said that adrenochrome is equally as important as adrenaline. The long-lasting effect of adrenaline on bleeding time is probably due to the adrenochrome into which it is converted. Recent observations with the electron microscope suggest, he said, that the neurotubules in nerve may transmit a constant though very slow flow of local hormones into the innervated tissue.

Dr. H. K. F. Blaschko, senior research officer in the Department of Pharmacology, University of Oxford, discussed analogies between enzyme-substrate relationship and the affinity of local hormones for the excitable tissue. Enzymes which show stereochemical specificity for one steric configuration are assumed in the enzymic reaction to have a fixed spatial arrangement, relative to the enzyme, of three at least out of the four groups attached to the asymmetric carbon atom. This was discussed for the bacterial and mammalian L-amino-acid decarboxylases which form adrenaline-like amines (tyramine, hydroxytyramine, *nor*adrenaline) from the corresponding L-amino-acids. Similarly, the specific action of lævoadrenaline must be due to an engagement of three of the four groups surrounding the asymmetric carbon atom. These are: the catechol group, the basic group and the aliphatic hydroxyl group. The lesser activity of dextro-adrenaline is explained by assuming that only the catechol and basic groups are engaged, but that the hydroxyl group is not. The same mode of attachment occurs in epinine, a compound in which the aliphatic hydroxyl group of adrenaline is replaced by hydrogen; this compound is about as active as dextro-adrenaline.

OBITUARIES

Prof. John Ryle

THE death of John Alfred Ryle on February 27 at the age of sixty-one was not unexpected. Nevertheless, now that it has occurred, it is a shock, for he had been occupying an exceptionally important position in academic medicine and it will be difficult indeed to find a successor of like stature.

When in 1942 the chair and Institute of Social Medicine were created at Oxford, nothing was so important as the choice of the man to occupy that chair and to direct the development of that Institute. He had to assume responsibility for giving definition to the subject, for establishing its relationships with other departments of academic medicine and for creating or reshaping within the Institute the instruments of teaching and research within the general field of social medicine when this had been surveyed.

John Ryle was chosen and there could have been no better, no more fortunate choice. The attractiveness, to oncoming youth and to the utilizer of knowledge, of a particular field of human activity is, to a large extent, determined by the attractiveness of those who work therein. In his person, John Ryle was an attractive creature, displaying a beauty of body and of mind that was embellished by a nobility and strength of character and a glad devotion to medicine, both as the application of science and as an expression of a love of humanity. Professionally, he stood on a pinnacle, for he was regius professor of physic in the University of Cambridge and was loaded with honours. Yet from this pinnacle he stepped down because the post which was offered to him promised him exceptional opportunities for doing what his own experience and expanding philosophy were driving him to do—to take a personal and active part in, and to expedite the changes in interest and emphasis within, medicine that were reshaping medical thought and action.

Without hesitation he left all that his place in Cambridge represented, and in late middle age entered on what was tantamount to a new career. He, who had thus far concerned himself with the illness of individuals, now began to play his part in the adaptation of medicine for the preservation and augmentation of the health of the population as a whole.

As his ideas took shape they were presented in published papers which will claim a permanent place in the history of social medicine. He visited India, South Africa and the United States of America, there to display his developing notions, to offer his views for critical consideration and to influence policy in relation to the teaching of medicine in these countries. His annual reports and his "Changing Disciplines" give an account of these events.

In Oxford he soon collected around him a strong group of younger people who, fired by his enthusiasm, quickly made the Institute widely known by their published works, now a fitting monument to their dead leader.

Because the chair and Institute were created in Oxford, and because John Ryle went to Oxford and worked there, chairs of social medicine now exist in several other British universities, and academic departments of public health everywhere are changing their names.

John Ryle's life was fuller and more complete than those of most men for the reason that he was more gifted and more dedicated than most. To the end he welcomed change and to the end he pursued it. He once wrote: "Dying is not so terrible as we have been led to believe. It is often the witnesses who suffer the greater mental pain. Their suffering is usually a matter of untutored sympathy—of imagining what the victim must be feeling and imagining what they themselves may be called upon to endure. In their leave-taking from their friends the dying may or may not feel a fleeting wistfulness, but they will know no terror."

His many friends will find comfort in the thought that these observations were surely confirmed in John Ryle's own experience. F. A. E. CREW

Dr. A. E. M. G. Gillam

THE death occurred on January 16 of Dr. A. E. M. G. Gillam, a senior lecturer in the Department of Chemistry in the University of Manchester, at his home in Timperley, Cheshire. Gillam was born in Wavertree, Liverpool, in 1900. On leaving school he joined the technical staff of the Department of Inorganic Chemistry in the University of Liverpool under Prof. E. C. C. Baly, where he soon showed his talents as a lecture demonstrator, becoming the principal demonstrator on the death of the late Mr. Froysell. He studied in the evenings at the Central Technical School (now the Technical College) to obtain his associateship of the Institute of Chemistry in 1926, and served the College afterwards as a part-time assistant lecturer.

Continuing as the lecture demonstrator, he began research under Dr. R. A. Morton at the University and studied the absorption spectra of halogens and interhalogen compounds, methods for determining ultra-violet light intensity and the deterioration of fused quartz and of quartz mercury-vapour lamps. For an outstanding thesis on this work he obtained the M.Sc. degree in 1929.

At this period the value of absorption spectra in the study of conjugated unsaturated compounds became clear, and Gillam applied the method to the carotenoids and vitamin A in conjunction with Prof. (now Sir Ian) Heilbron and his collaborators. This led to the discovery in 1937 of vitamin A_2 in the liver oils of freshwater fish. The ultra-violet absorption spectrophotometric methods were applied to ergosterol and vitamin D precursors as well as to carotenoids. Later he investigated systematically the absorption of conjugated unsaturated carbonyl compounds to obtain the reference data for structural interpretations of these types. The method was further applied to polyphenyls, terpenes and many problems referred to him by colleagues in many walks of life, whom he was most willing to help.

He followed Heilbron to Manchester as research assistant in chemical spectroscopy in October 1933 and became a special lecturer in 1935. In 1937 Liverpool awarded him the D.Sc. degree. In 1938 he took charge of the first-year medical chemistry course at Manchester and showed his great gift as a teacher and demonstrator for eight years.

Gillam will be most remembered for his unfailing courtesy and help to others, whether colleague, student or service staff. Perhaps his own early educational handicap gave him a particularly sympathetic understanding of the difficulties of elementary students. In 1946 he became a senior lecturer, but soon afterwards his health deteriorated and he died after a long illness borne with characteristic courage.

It is hoped that his nearly completed book on ultra-violet absorption spectra will be finished by his colleagues.

Gillam served the Chemical Society for six years as local representative, had been local examiner for the Royal Institute of Chemistry and served as chairman of the Manchester branch of the Association of University Teachers; for the Bureau of Abstracts he undertook in 1946 the onerous responsibility for the new formula index. In all these activities he did more than his share unselfishly and efficiently. He was also a keen amateur ornithologist and had made some beautiful bird photographs. He leaves a widow and two sons.

T. H. H. QUIBELL

Prof. Mosharrafa Pasha

DR. ALI MOSTAFA MOSHARRAFA PASHA, professor of applied mathematics and dean of the faculty of science in the Fouad I University, Cairo, died on January 16, aged fifty-two years.

After graduating from the Higher Training School, Cairo, in 1917, he came on mission to England until 1923. Spending most of this time in the University of London in study and research, he obtained his doctorate in science and became known as an earnest and brilliant student. Returning to Egypt, he joined the staff of the Higher Training School.

When, in 1925, the Egyptian University was founded, he was appointed assistant professor of applied mathematics and, in the following year, head of the Department of Applied Mathematics. In 1936 he was elected dean of the faculty of science in the Egyptian University, which was re-named Fouad I University. He was the first Egyptian to hold this position.

As dean of the faculty of science, and a prominent member of the University, he always aimed for the maintenance of a high academic standard, and the encouragement of research. In this regard he was fully alive to the necessity of a close contact with the older universities in Europe, and any suggestions in this direction always had his strong support. He lent all his influence in initiating the sending of graduates to British universities for research under more liberal conditions than before, not only in the fields of mathematics and physics, but also in biological subjects. As soon as travel became possible at the end of the War, he exerted his influence in bringing prominent men, in all branches of science, on visits to the University.

His earlier work (1923–25), published in the *Philosophical Magazine* and the *Proceedings of the Royal Society of London*, dealt with the quantum theory, and was followed by a series of papers to societies in England on mathematical and physical problems. In 1937, Mosharrafa founded the Mathematical and Physical Society of Egypt. This was a great step in the organisation of science in Egypt. He also took a leading part in the adaptation of the Arabic language into a medium of expression of scientific thought, and the re-editing of the old Arabic scientific writings.

He was a man of great energy and unfailing courage in striving for what he considered high standards of university teaching and originality in research. His death is a heavy loss to scientific developments in Egypt.

F. J. LEWIS

WE regret to announce the following deaths:

Prof. J. A. Crowther, emeritus professor of physics in the University of Reading, on March 25, aged sixty-six.

Prof. C. S. Gibson, O.B.E., F.R.S., emeritus professor of chemistry in the University of London at Guy's Hospital Medical School, on March 24, aged sixty-six.

Prof. Alexander Klemin, Guggenheim research professor of aeronautical engineering, New York University, aged sixty-one.

Prof. T. H. Milroy, emeritus professor of physiology, Queen's University, Belfast, on March 20, aged eighty.

Prof. G. R. Minot, professor of medicine at Harvard University during 1928–48, who shared the Nobel Prize for Medicine in 1934, on February 25, aged sixty-four.

Prof. F. W. Twort, F.R.S., lately superintendent of the Brown Institution and professor of bacteriology in the University of London, on March 20, aged seventy-two.

NEWS and VIEWS

Scientific Civil Service: Research Promotions

IT is announced that further special posts have been created this year for individual research workers of exceptional merit under provisions included in the White Paper on the Scientific Civil Service (Cmd. 6679; 1945). The promotions this year include two to the grade of deputy chief scientific officer, which is regarded as broadly equivalent in status to an appointment to a university chair; this is the first occasion on which special promotions on individual merit have been made under this scheme at this level.

Deputy Chief Scientific Officers

Dr. R. A. Frazer, of the National Physical Laboratory, an international authority on aircraft flutter, who supervised the theoretical and experimental researches which laid a secure foundation for the modern theory of flutter. He was elected to the Royal Society in 1946 for his distinguished work in this field. After the First World War he conducted nearly all the full-scale research in Great Britain on rigid airships; latterly he has been in charge of research on aerodynamic oscillations of suspension bridges which is being carried out for the Ministry of Transport. Dr. Frazer is a member of the Mechanics Committee of the Aeronautical Research Council.

Mr. S. B. Gates, of the Ministry of Supply, known for his work on aerodynamics, combines a deep physical insight with exceptional appreciation of practical considerations of importance to designers and pilots, and has earned an international reputation as an authority on questions connected with the spinning stability and manœuvrability of aircraft. Mr. Gates received one of the first awards given in 1947 under this scheme when he was promoted to a post in the grade of senior principal scientific officer. He has been elected to the Royal Society this year.

Senior Principal Scientific Officers

Dr. E. F. G. Herington, of the Chemical Research Laboratory, Department of Scientific and Industrial

Research, a physical chemist who has made notable contributions to knowledge of the mechanism of catalyst polymerization and of the theory of solutions.

Dr. C. H. Lea, of the Low Temperature Research Station, Cambridge, author of many publications containing valuable contributions to the chemistry of fats. Among these, his "Rancidity in Edible Fats", first published in 1938 and now being revised, is a standard work. Just before and during the Second World War, he did work of much practical value on the prevention of deterioration in full-cream milk powders.

Royal Geographical Society: Awards for 1950

H.M. THE KING has approved the award of the Royal Medals of the Royal Geographical Society as follows: *Founder's Medal* to Mr. George F. Walpole, director, Department of Lands and Survey, Kingdom of the Jordan, for his contributions to the mapping of the Western Desert of Egypt; *Patron's Medal* to Prof. Harald Sverdrup, director of the Norwegian Polar Institute, for his contributions to polar exploration, and for his oceanographical investigations.

The Council of the Society has made the following awards: *Victoria Medal* to Prof. Emmanuel de Martonne, honorary director of the Geographical Institute, University of Paris, and honorary president of the International Geographical Union, for his studies in physical and regional geography; *Murchison Grant* to Surgeon-Commander E. W. Bingham, for his services to Antarctic exploration as leader of the Falkland Islands Dependencies Survey Expedition, 1945–47; *Back Grant* to Mr. R. G. Goodchild, deputy director of the British School at Rome, for his archæological reconnaissances and surveys of the Roman frontier zone of Tripolitania, 1946–49; *Cuthbert Peek Grant* to Mr. R. F. Peel, lecturer in geography at the University of Cambridge, for work on the ethnology and morphology of parts of the Libyan Desert, and on the morphology of northern English rivers; *Gill Memorial* to Dr. E. C. Willatts, senior research officer, Ministry of Town and Country Planning, for his work for the Land Utilization Survey of Great Britain and for geographical studies in Palestine with the Anglo-American Commission, 1946.

Institute of Metals: W. H. A. Robertson Medal

THE first award of the W. H. A. Robertson Medal of the Institute of Metals has been made to Mr. W. J. Thomas and Mr. W. A. Fowler, assistant managing director and production manager (manufactured materials), respectively, of the British Aluminium Co., Ltd., for their paper on "Some Technical Problems Influencing Production Economy in the Rolling of Aluminium" (*J. Inst. Metals*, **75**, 921; 1949). The Medal is open to persons of any nationality and is awarded annually to the author or authors of the paper adjudged to be of the highest merit contributed to the *Journal of the Institute of Metals* on engineering aspects of non-ferrous metallurgy.

The Institute has received from Imperial Chemical Industries, Ltd., a sum of money sufficient to found a medal to be awarded as a memorial to the late Dr. Walter Rosenhain, a past-president of the Institute. The medal, which is now being designed, will be awarded annually for outstanding contributions to knowledge in the field of physical metallurgy and will be open to individuals less than forty-five years of age, irrespective of sex and nationality.

Technical Committee for Pest Control Products

GREAT advances have been made in the development of chemicals for pest, disease, weed and rodent control, and during the past ten years, in particular, many new compounds have been marketed on a world-wide scale for use in the medical, veterinary, agricultural and industrial fields. The chemical names of these compounds have, in many instances, been too complicated for common use, and shortened forms and trade names have been devised. As there may be several of these applied to one chemical compound, confusion has arisen in commercial descriptions of products and also in the scientific literature. The problem was discussed at the Commonwealth Entomological Conference in 1948, and a resolution passed urging the appointment of a committee to agree on common names for established compounds. The executive council of the Commonwealth Agricultural Bureaux referred the recommendation to the British Standards Institution, which has now appointed a Technical Committee for Nomenclature of Pest Control Products, with terms of reference "To prepare standards for the nomenclature for insecticidal and fungicidal chemicals and other pest control products". The Committee wishes the interested public to suggest common names and to submit information regarding new products for which a common name is required. With the ultimate hope of arriving at international agreement on nomenclature, it is working in close collaboration with the standards organisations in Commonwealth and other countries, and with the Inter-Departmental Committee on Pest Control in the United States. The Committee includes representatives of Commonwealth countries, government departments, scientific societies and manufacturers' organisations, and is under the chairmanship of Mr. H. J. Jones, who is also chairman of the Pest Control Products Industry Standards Committee of the Institution, with Dr. Catherine Tinker as secretary.

British Standard for Steel-Pipe Flange Fittings in the Petroleum Industry

BRITISH Standard 1560 (1949) is one of a series concerned with specialized equipment for the petroleum industry. It is, in effect, a companion document to British Standard 1575 (cast-iron pipe flanges and flanged fittings, Class 125) and British Standard 1576 (cast-iron pipe flanges and flanged fittings, Class 250), which are also concerned with oil production and refining. Close co-operation between the British Standards Institution, Council of British Manufacturers of Petroleum Equipment, Institute of Petroleum, Ministry of Fuel and Power, Oil Companies Materials Committee and the British Iron and Steel Federation, on one hand, with the American Petroleum Institute, American Society for Testing Materials and the American Standards Association, on the other, has resulted in this urgently required specification. It has therefore been prepared in a manner to ensure interchangeability in practice between equipment produced by American and British manufacturers. This specification concerns essentially design and construction of flanges and flanged fittings; details of dimensions; materials; and pressure-temperature ratings, marking and threading of pipe. This, and the other specifications mentioned, presage in the near future the important British Standard schedule of steels for the petroleum industry which is long overdue and which we are

informed is to be available shortly. In view of the considerable tabular matter in British Standard 1560, the format is not the familiar Standard publication, but is a large quarto size (8½ × 11 in.); it is to be hoped that this does not create a precedent. One of the great advantages of British Standard publications is their uniformity in make-up and presentation, almost entirely independent of the vast range of subjects covered. It would be a pity to see this principle dropped, even if it does mean an addition to cost (in this case 12*s.* 6*d.*) and bulk of these indispensable and invaluable British technical mandates.

The "Biblia Naturæ" of Swammerdam

THE following notes by Prof. F. J. Cole, formerly of the University of Reading, referring to the original drawings of this great work, which are preserved in the Library of the University of Leyden, may be useful to students of the history of comparative anatomy. The figures of the plates were first sketched in with sanguine and then completed with pen or pencil. The shading is pencilled or executed in neutral wash. They are the work of an unknown artist; but one of the Ephemera plates is signed "Delineavit auctor". Swammerdam's working life as a naturalist ceased *c.* 1675. Many of the drawings are missing, and must be regarded as beyond recovery. In the volume as now bound their place is taken by cuttings from the engraved and printed plates of the posthumous first edition of 1737–38. Thus of the fifty-three plates which constitute a complete set, thirty-three only, namely, 2, 6, 11, 14, 17–21, 23–30, 34–36, 40–45, 47–53, are made up from the original drawings, while ten, namely, 4, 5, 7–10, 13, 15, 22, 46, are represented by engraved substitutes. The remaining ten are mixed as follows: Plate 1: only Figs. 4, 7, 8 are original. Plate 3: the three figures of the external characters of the scorpion are from the engraved plates. Plate 12: only Figs. 3–7 original. Plate 16: only Figs. 12–16 original. Plate 17: original drawings *very faint* and difficult to photograph satisfactorily. Plate 24: alate face with injection tube poorly drawn—this has been improved in the engraved version. Plate 31: only Figs. 4, 6 and 8 original. Plate 32: only Fig. 3 and one of the wings of Fig. 2 original. The other (printed) wing is crossed out. The original wing shows veins *and* scales and the printed wing only the veins. In the 1669 work only veins are shown on both sides, but in the "Biblia Naturæ" both wings show veins and scales. The latter state is obviously the 1669 version completed. Plate 33: only Fig. 8 original. Plate 37: only Figs. 1 (ovum) and 11 original. Plate 38: only the six figures down the right side of the plate original (rat-tail larva, etc.). Plate 39: Figs. 1 and 2 not original.

Quantitative Study of Foot-and-Mouth Disease Virus

QUANTITATIVE methods are often difficult of application in biological problems, yet the progress in an investigation usually depends upon the exactitude of measurements which can be made. Estimation of the strength of virus preparations is perhaps a classical instance of such difficulty, and contributions in method are here very welcome. W. M. Henderson has made a detailed study of the validity of various means of assessing the relative strength of the virus of foot-and-mouth disease (Agricultural Research Council Report Series No. 8. Pp. 58. London: H.M. Stationery Office, 1949; 2*s.* 6*d.* net). The usual method of titrating virus by inoculation to guinea pigs is shown to be inadequate, because bovine strains require serial adaptation before they are fully effective upon the smaller host. Inoculation of each dilution to a separate bovine host would involve prohibitive cost. Dr. Henderson has, however, succeeded in combining effectiveness with reasonable cost by the introduction of four dilutions, each with five inoculation sites, upon the tongue of one Devon steer 1½–2 years old. Highly significant results are given if two animals are used, that is, ten inoculations of each dilution. These results are of fundamental importance, and not only in the study of animal viruses. Sufficient is known about plant viruses to warrant the conclusion that similar phenomena would obtain in this realm of study. It is, indeed, largely for this reason that the Agricultural Research Council has made this work readily available to workers in a wider field, by issuing it as one of its Report Series.

University of London: Athlone Press

A STATEMENT in the *University of London Gazette* of February 25 announces that the University has established a means of publication, which has been named the Athlone Press, to distinguish it from the University of London Press, Ltd. Mr. W. D. Hogarth has now been appointed secretary to the Press, with offices in the Senate House, W.C.1. It is the function of the Press to publish works in the following categories: (i) public lectures delivered at the invitation of the University; (ii) the work of graduates of the University, of appointed and recognized teachers, and of other members of the staff of the University, or of the central institutions or schools of the University, whether to be published separately, or in series; (iii) such works included in series and such periodicals, sponsored by schools or central institutions of the University, as may be submitted to and accepted by the Board of Management; (iv) such other works as the Board of Management may accept. The funds at the disposal of the Board of Management are strictly limited, and the Board has decided to carry out a preliminary survey of the proposals for publication likely to be made to it in the near future by or through schools, central institutions and boards of studies of the University. All inquiries should be addressed to the Secretary to the Athlone Press, Senate House, London, W.C.1.

Society of Public Analysts and Other Analytical Chemists: Annual Meeting

THE seventy-sixth annual general meeting of the Society of Public Analysts and Other Analytical Chemists was held on March 17 in the meeting room of the Royal Society, Burlington House, London, W.1, with the president, Mr. George Taylor, in the chair. The financial statement and the report of the Council for the past year were submitted and approved. It was reported that the membership of the Society had increased by 51 to 1,547. In addition to seven meetings of the Society, twenty-four meetings were held by its sections and groups in the course of the year. From the beginning of 1950 some far-reaching changes were made to the Society's journal, *The Analyst*, of which the most noticeable is the disappearance of the abstracts section; in its place members and subscribers have been supplied with *Abstracts C*, which is less detailed in nature but covers a far wider field than *The Analyst* has ever before reviewed. At the conclusion of the meeting

the first Bernard Dyer Memorial Lecture was delivered by Sir John Russell.

The following officers and members of Council were elected for the ensuing year: *President*, G. Taylor; *Past Presidents serving on the Council*, L. Eynon, E. B. Hughes, G. Roche Lynch and G. W. Monier-Williams; *Vice-Presidents*, D. C. Garratt, J. G. A. Griffiths and J. R. Nicholls; *Honorary Treasurer*, J. H. Hamence; *Honorary Secretary*, K. A. Williams; *Other Members of Council*, A. L. Bacharach, H. H. Bagnall, J. Haslam, D. W. Kent-Jones, A. A. Smales and E. Voelcker. R. C. Chirnside, E. T. Illing, J. King, C. J. Regan and N. Strafford remain on the Council from the 1949 election, and the following chairmen of sections and groups are *ex-officio* members of the Council: J. G. Sherratt (North of England Section), J. Sword (Scottish Section), R. Belcher (Microchemistry Group), B. S. Cooper (Physical Methods Group) and N. T. Gridgeman (Biological Methods Group).

Institute of Welding: Spring Meeting

THE spring meeting of the Institute of Welding will be held at the Grand Hotel, Colmore Row, Birmingham 3, during April 25–28, with one day (April 27) to be spent at the Victoria Hotel, Wolverhampton. Some technical papers will be read on April 26 and 27; but a large proportion of the programme will be devoted to excursions and visits to places of technical and general interest. Further particulars can be obtained from the Secretary, Institute of Welding, 2 Buckingham Palace Gardens, Buckingham Palace Road, London, S.W.1.

Royal Photographic Society: Officers for 1950

THE annual general meeting of the Royal Photographic Society was held on March 21, when the following elections were made: *President*, L. V. Chilton; *Vice-Presidents*, I. D. Wratten and Bertram Sinkinson; *Treasurer*, Harry Abbott; *Ordinary Members of Council*, Gilbert Adams, S. W. Bowler, G. Scott Bushe, K. H. Gaseltine, P. Hansell, Miss M. F. Harker, R. G. Hopkinson, J. Dudley Johnston, G. A. Jones, S. D. Jouhar, W. A. Lynch, A. Pearlman, A. L. M. Sowerby, A. A. Walker, Harold White.

The Night Sky in April

FULL moon occurs on April 2d. 20h. 49m., U.T., and new moon on April 17d. 08h. 25m. The following conjunctions with the moon take place: April 2d. 00h., Mars 3° N.; April 12d. 13h., Jupiter 3° N.; April 13d. 01h., Venus 4° N.; April 19d. 04h., Mercury 1° S.; April 28d. 07h., Saturn 0·02° N.; April 28d. 23h., Mars 0·8° N. In addition to these conjunctions with the moon, Venus is in conjunction with Jupiter on April 5d. 11h., Venus being 2·3° N. Mercury, an evening star, sets at 18h. 50m. and 21h. 07m. at the beginning and end of the month respectively, but in the early portion of April is too close to the sun for favourable observation. Venus is a morning star, rising an hour and a half before the sun on April 1 and about an hour before the sun on April 30, and can be seen for a short period before sunrise, stellar magnitude −4, half its illuminated disk being visible on April 12. Jupiter, a morning star, can be seen after the middle of the month when it rises about an hour and a half before the sun; but it lies low in the heavens and is not well placed for observation. Saturn, in the constellation of Leo, sets in the early morning hours and can be seen throughout the night; the ring is now easily seen with a small telescope. Occultations of stars brighter than magnitude 6 are: April 6d. 01h. 47·3m., *A* Scor. (*R*); April 6d. 03h. 48·9m., π Scor. (*D*); April 20d. 19h. 42·8m., χ Taur. (*D*); April 23d. 22h. 19·0m., 47 Gemi. (*D*). *R* and *D* refer to reappearance and disappearance respectively, and the latitude of Greenwich is assumed. On April 2 there is a total eclipse of the moon, visible at Greenwich:

Moon enters penumbra	April	2d.	18h. 09·3m.
Moon enters umbra		2	19 09·0
Total eclipse begins		2	20 29·5
Middle of eclipse		2	20 44·1
Total eclipse ends		2	20 58·7
Moon leaves umbra		2	22 19·2
Moon leaves penumbra		2	23 18·8

Announcements

THE Council of the Linnean Society of London has selected Mr. H. N. Ridley for the award of the Linnean Medal for the year 1950. The presentation will be made at the anniversary meeting on May 24. The Linnean Medal is awarded to an eminent biologist as an expression of the Society's estimate of his services to science.

A NEW quarterly review, *Maveg*, is to be published shortly. The journal, the name of which is an abbreviation of *Materiæ Vegetabiles*, will deal with all aspects of plant products useful to man. Articles will be published in various languages; but if not in English then an English summary will be attached. Further information can be obtained from *Maveg*, Zollikofer and Co., Imprimerie et Editions, Gutenbergstrasse 13, St. Gallen, Switzerland.

THE annual conference of the X-Ray Analysis Group of the Institute of Physics, to be held at the Royal Institution, Albemarle Street, London, W.1, during April 13–14, will be devoted to a discussion of "The Production and Application of High-Intensity X-ray Beams". The several sessions will be devoted to high-power X-ray tubes, monochromators and collimators, techniques of X-ray analysis, and application of high-intensity X-ray beams. Prof. A. Guinier, of the Conservatoire National des Arts et Métiers, Paris, will give an evening lecture on "The Role of High-Intensity Beams in the Progress of X-ray Analysis". Further information can be obtained from the Deputy Secretary, Institute of Physics, 47 Belgrave Square, London, S.W.1.

THE Ministry of Agriculture and Fisheries is offering the following scholarships to young persons who are working in agriculture or who are the children of agricultural or rural workers: for those over the age of seventeen, ten senior scholarships, tenable at university departments of agriculture, or agricultural colleges, for degree or diploma courses in an agricultural subject, or at veterinary colleges for courses in veterinary science; for those under seventeen, six extended junior scholarships and sixty junior scholarships, tenable at farm institutes or similar institutions, for courses, not exceeding one year in duration, in agriculture, horticulture, dairying or poultry husbandry. Forms of application, to be returned by April 30, can be obtained from the Secretary (Room 314), 1 Cambridge Terrace, Regent's Park, London, N.W.1, or from the education offices of county councils.

ERRATUM. In the letter on "Dispersion of the Birefringence in Barium Titanate", by Cross *et al.*, in *Nature* of March 18, p. 440, the ordinates of the graph (Fig. 2) are incorrectly labelled; the observed birefringences are one-tenth of those shown.

REVERSAL OF INHIBITION OF RESPIRATION AND SALT ABSORPTION BY CYANIDE AND AZIDE

By Prof. H. LUNDEGÅRDH
Institute of Plant Physiology, Uppsala 7

THE aerobic respiration of many plant tissues is the sum of at least two groups of processes, namely, the ground respiration and the anion (salt) respiration[1]. The anion respiration regulates the absorption and the transport of salts through organs and tissues. Cyanide and azide are strong inhibitors of this phenomenon, whereas the ground respiration remains unaffected by 0·001 *M* potassium cyanide. The anion respiration is probably identical with the cytochrome–cytochrome oxidase system, and a number of observed facts support the hypothesis that the transport of anions is co-ordinated with the transference of electrons from a donor to oxygen, mediated by the shift of valency of the iron atoms of the system[2]. This activity of the iron atoms is blocked by the compounds formed between Fe^{3+} and cyanide or azide. It is commonly believed that this blocking is unavoidable unless the inhibitor is washed out from the tissue.

Observations of the respiration of wheat roots under prolonged influence of these inhibitors revealed the existence of a hitherto unknown process of recovery through which the poisonous effect of the inhibitor is more or less completely reversed. The experiments were performed in 'circulation vessels'[1] in which 100 c.c. of solution is continuously stirred by a gas stream (oxygen, air, or nitrogen plus oxygen, permitting a wide amplitude of actual oxygen tension). The roots of fourteen intact seedlings of spring wheat ('low salt and high sugar content'), held together by a special cork holder, are submerged in the solution. The time-course of the ion absorption (mostly from 0·0005 *M* potassium chloride) was automatically recorded as the decrease of conductivity of the solution at intervals of six minutes. A 'Speedomax' (Leeds and Northrup) with six points enabled the running of series of five vessels plus one control. Extensive tests showed a parallelism within a few per cent between the conductivity and the absorption of chloride in series with cyanide and azide. With inhibitors interfering with glycolysis (iodo-acetic acid, fluoride, 2,4-dinitrophenol) the agreement is less good, owing to increasing exudation of ionized compounds (nucleic acids, etc.) from the roots. For the determination of the respiration, roots were removed from the experimental vessels at certain intervals and transferred to closed 50-c.c. flasks (see ref. 3; Winkler method for the determination of the oxygen consumption).

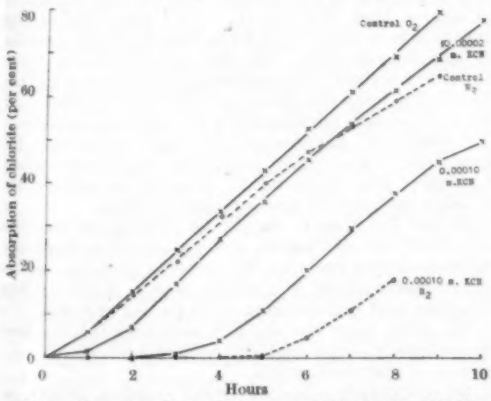

Fig. 1. Absorption of chloride from 0·0005 *M* potassium chloride under the influence of different concentrations of potassium cyanide. ×——×, aeration with oxygen; o - - - - o, aeration with nitrogen + 1 per cent oxygen

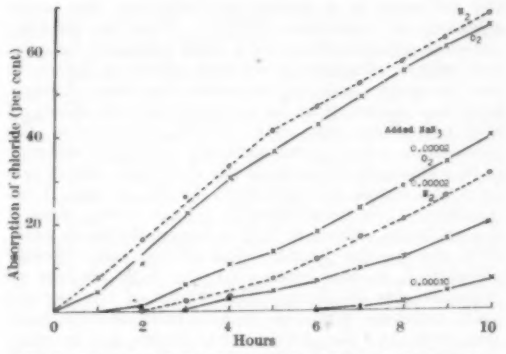

Fig. 2. The same as in Fig. 1, but sodium azide instead of cyanide

Figs. 1 and 2 show that absorption of chloride proceeds uniformly from 0·0005 *M* potassium chloride (controls). The absorption is only slightly influenced by decreasing the concentration and by variations of the oxygen tension corresponding to 1·1 millimol./litre (aeration with oxygen) down to 0·05 millimol. (aeration with nitrogen + *c.* 1 per cent oxygen). After the addition of small quantities (see graphs) of cyanide or azide, the chloride absorption is almost instantaneously inhibited; and the inhibition lasts for a period of less than one hour up to several hours, dependent upon the concentration of the inhibitor. In 0·00002 *M* sodium azide the recovery starts in *c.* 1 hr., in 0·00010 *M* the lag is *c.* 6 hr. (Fig. 2). In the presence of potassium cyanide the recovery appears somewhat earlier (see Fig. 1). The reversion of the inhibition begins slowly and accelerates during one to several hours until the absorption intensity of the controls without inhibitor is approximately attained. A further rise above this limit was not observed. The process of recovery is positively influenced by the oxygen tension. The period of inhibition is prolonged at low tension (0·05–0·07 millimol. oxygen/litre), but the final acceleration is of a similar magnitude as at high oxygen tension. The reversion of the cyanide–azide inhibition of the salt absorption is accompanied by a corresponding rise of the respiration, measured as oxygen absorption. In the period of full inhibition, only the ground respiration (R_g) is going on. In wheat roots it amounts to *c.* 0·80–1·20 μmol. oxygen per 10 mgm. dry weight, 1 hr. at 18–20° C. In 0·0005 *M* potassium chloride alone, the anion respiration (R_a)

is superposed on R_g, the total respiration ($R_t = R_g + R_a$) amounting to *c.* 2·00–3·00 μmol. oxygen/10 mgm., 1 hr. (a 'third respiration'[3] in the lower parts of the growing roots can be practically neglected in the present case, because roots of *c.* 100 mm. length were used). The investigation of the respirational qualities of the recovering roots thus includes two single determinations: (1) of R_t in potassium chloride alone, and (2) of R_g in potassium chloride + 0·001 *M* potassium cyanide, the latter being strong enough to bring the recovered roots back to a complete inhibition of R_a.

It was mentioned earlier that the quotient

$$\frac{\text{absorbed anions}}{\text{consumed oxygen}} \text{ (or, } Q^{an}/O_2)$$

remains approximately constant in the period when retardation of R_a is beginning; for example, under the influence of a partial inhibition in very weak solutions of potassium cyanide[2]. This fact strongly supports the hypothesis of a close causality between the valency changes of the iron atoms of the cytochrome system and the transport of anions. Robertson[4] has shown that in suitable objects (slices of storage tissue), the ratio Q^{an}/O_2 approaches the theoretical value 4, corresponding to the transference of four electrons to one molecule of oxygen. The reason why the values for the ratio Q^{an}/O_2 remain comparatively low (maximum *c.* 1·0) in roots, even if the salts are offered in high concentrations, is probably due to the participation of the salts already circulating in the roots plus the high content of organic acids in them. The anions of the organic acids compete with the neutral salts as objects of transport in the anion respiration mechanism[2]. According to this competition the ratio Q^{an}/O_2 decreases to *c.* 0·40–0·70 if the absorption from very diluted solutions is measured, because in this case the frequency of ion absorption from the medium is rather low in comparison with the frequency of anions already present in the absorbing tissue. So long as the relation between inorganic and organic ions holds approximately constant, however, the ratio Q^{an}/O_2 also remains approximately constant.

Determinations of the ratio Q^{an}/O_2 during the time-course of salt absorption yielded the following average values from three series of experiments with cyanide and azide, together with 0·0005 *M* potassium chloride.

	KCl alone (throughout)	KCl + inhibitor (recovery period)	
		0·00002 *M*	0·00010 *M*
Q^{an}/O_2 =	0·68	0·62	0·70

The maintenance of the quantitative relation between the anion respiration and the absorption of anions also during the period of recovery points to a reactivation of the cytochrome–cytochrome oxidase system. Moreover, this conclusion is supported by the fact that the process finally regains its original speed (see graphs). In its recovered stage the anion respiration can be again inhibited by cyanide, but then considerably stronger solutions must be used.

These results give a new illustration to the common power of adaptation, but the phenomenon seems to be different from that of the antitoxins. The inhibitor is probably not eliminated by the linkage to an anti-inhibitor slowly formed in the cells. It seems more appropriate to assume a change in the affinity of the iron atoms for the inhibitor. Several facts, for example, the competition between cyanide and oxygen, indicate such a position of the active iron atoms of the oxidase that the inhibitor is less firmly bound. It is known that cytochrome *c* is much more slowly affected by cyanide than cytochrome oxidase, and other hæmin enzymes also illustrate differences of sensitivity to cyanide. A possible explanation of the observed recovery is the existence of a certain variability in the configuration of the cytochrome oxidase and its change, under the influence of the inhibitor, to a molecular structure less attractive to cyanide and azide. Such a change in the position of the active iron atoms would be reflected in the physical properties of the enzyme.

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REVERSIBLE DILATION AND CONTRACTION BY CHANGING THE STATE OF IONIZATION OF HIGH-POLYMER ACID NETWORKS

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It was shown recently that the shape of ionizable polymeric molecules (for example, polyacids and polybases) depends in a sensitive manner on the degree of ionization, that is, on the number of charges distributed over the molecular chain[1–4]. Charging the molecule, for example, by ionizing the carboxyl groups of a polyacid, produces an electrostatic repulsion along the chain and causes an expansion of the originally coiled molecule.

In the case of samples of polymethacrylic acid in aqueous solution, as investigated by us, about 50 per cent ionization is sufficient to stretch the molecules to almost their full length. The uncoiling of the molecule is accompanied by a very marked increase in specific viscosity. In the case of dilute high-molecular weight polymethacrylic acid solutions, we found, for example, that the specific viscosity had risen some two thousandfold at half-neutralization. As observed experimentally and explained by quantitative theoretical considerations, the stretched molecules can be made to contract reversibly by suitable addition of acid or neutral salts.

It was felt that it should be possible to transfer the molecular extensions and contractions from the submicroscopic scale to macroscopic systems, which would then imitate, to a certain degree, the reversible dilations and contractions of biological systems.

We have been successful in realizing this by two procedures[5,6], both leading to three-dimensional networks of polymeric acids.

(*a*) *Polyacrylic acid cross-linked by esterification with polyvalent alcohols.* A three-dimensional network, consisting mainly of polyacrylic acid, can be obtained by heating a foil of polyacrylic acid containing a

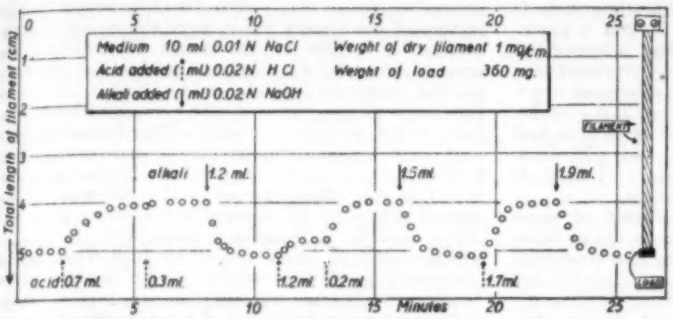

Fig. 1. Reversible lifting and lowering of a load by a filament of cross-linked polyacrylic acid on adding acid and alkali alternately to the surrounding medium

polyvalent alcohol, such as glycerol or polyvinyl-alcohol, with or without addition of small amounts of catalyst (for example, sulphuric acid or hydrochloric acid). These networks are insoluble but will swell in water to a degree depending on their alcohol content and on the temperature (100–140° C.) and duration (a few seconds to 24 hr.) of the heating period in their preparation. The gel obtained is then found to swell enormously on addition of alkali and to contract rapidly when acid is added to the surrounding solution. Linear dilations and contractions of the order of 300 per cent were observed. This cycle of swelling and de-swelling is reversible and can be repeated at will.

In order to obtain an *oriented* network, mechanical stress (up to 1,000 kgm./cm.^{2}) was applied during heating. At high temperature these filaments show rubber-like elasticity and plastic flow, so that under the applied stress they extend to about five to six times their original length. Removed under stress from the drying oven, they show permanent birefringence and do not contract again when stress is removed. We have found that the rate of 'vulcanization' is very much increased by stretching the foil in this manner.

Soaked in pure water, the filaments contract within a few seconds (to at most 50 per cent of their length) with strong lateral swelling (four times linear). The filaments, therefore, swell anisotropically. On alternating addition of acid and alkali, the anisotropic filaments also contract and lengthen reversibly and, while doing this, they are strong enough to carry a considerable load. The extent of the contraction depends on the conditions of esterification (temperature, duration, stress), on the salt content of the solution and on the load which the filament is carrying. For example, a certain filament, to which a piece of metal of weight 5,000 times the weight of 1 cm. of the dry filament was attached, changed its length reversibly at best by 30 per cent. Chemical energy is thus transformed directly into mechanical work. Filaments, 0·1 mm. thick when swollen, react within less than 1 min. (Fig. 1).

(*b*) *Polymethacrylic acid cross-linked by divinylbenzene.* Samples of crystalline methacrylic acid were copolymerized in methanol with 1, 2 or 4 per cent of divinylbenzene in the presence of benzoyl peroxide as catalyst. Before drying the resulting gel, non-polymerized material was thoroughly washed out of it with methanol. The copolymers thus obtained dilate and contract on treatment with alkali and acid respectively. They are, moreover, very suitable for a quantitative determination of the maximal swelling capacity of these systems as a function both of the degree of cross-linking and the degree of ionization. These experiments were performed by soaking the copolymer samples in water containing alkali, sufficient to neutralize a fraction α of the carboxyl groups in the polymer. The final degrees of swelling observed are represented in Fig. 2. It may be mentioned that the swelling capacity decreases with increasing degree of 'vulcanization'. The 1 per cent divinylbenzene copolymer has swollen some 550 times with a maximal linear magnification of 820 per cent. The swelling increases with the degree of neutralization and reaches a maximum, at $\alpha = 0{\cdot}5$–$0{\cdot}6$, which corresponds to almost fully stretched molecules.

Assuming the molecular chains to be joined with the benzene nuclei of divinylbenzene in a more or less regular manner (resembling the diamond structure), the molecular chain-length between cross-linking points of a fully swollen gel can be calculated. Thus from the swelling maximum ($q = 180$) of the copolymer containing 2 per cent divinylbenzene this chain-length is calculated to be 93·8 A., while the corresponding length of the fully stretched chain is 96·2 A., proving that in the ionized gel the molecules of the polymer are stretched to 97·5 per cent of their full length. These experiments demonstrate that the dilating forces—the electrostatic repulsion of the point charges along the chain and the osmotic pressure of the cations—are able to overcome the elastic retractile forces of the chain and stretch it as a whole.

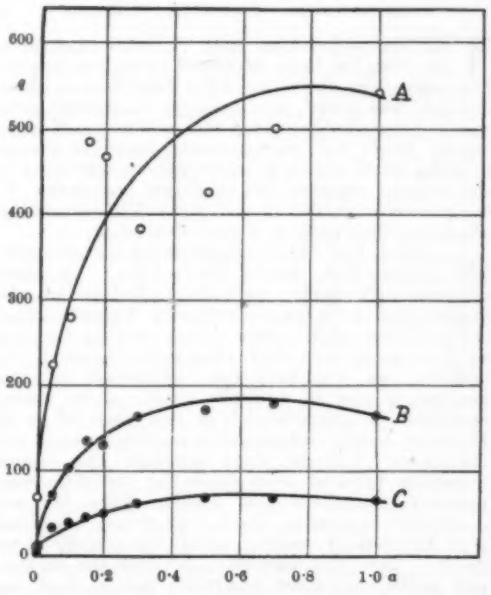

Fig. 2. Equilibrium swelling of cross-linked polymethacrylic acid at various degrees of neutralization with sodium hydroxide; temperature, 26° C.

A, 1% divinylbenzene; *B*, 2% divinylbenzene; *C*, 4% divinylbenzene

The working capacity of the contractile system is lowest at maximal swelling ($\Delta F = 0$), but a knowledge of the maximum swelling values is important for a fuller thermodynamic discussion of the mechanochemical properties of the polymers described.

Both sets of experiments prove that it is possible to realize on a macroscopic scale the stretching and coiling of charged macromolecules, and that it is possible, by means of these systems, to transform chemical energy into mechanical energy.

The quantitative theoretical treatment of these phenomena is based on the same arguments as those used for the explanation of the coiling and stretching of isolated chain molecules in solution. They involve (1) a statistical consideration concerning the entropy of a three-dimensional network; and (2) considerations concerning the electrostatic energy of the ionized system as a function of both the degree of ionization of the molecules and their degree of stretching in the swelling of the gel.

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RELATIONSHIP OF FIBRE QUALITY TO BACTERIAL FLORA IN FLAX RETTING

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THE undoubted superiority of Belgian processed flax fibre has been attributed to various factors. For many years, the water of the River Lys, in which the flax was retted, was believed to possess some special properties favouring the production of high-quality fibre; but, more recently, since the change to warm-water retting in tanks without detriment to the Belgian product, the emphasis has shifted to the greater manipulatory skill of the Belgians and the inherently high quality of their flax straw.

Australian flax fibre compares very unfavourably with Belgian fibre, despite the fact that it is retted by essentially similar methods. Chief among the factors blamed for the mediocrity of Australian fibre is the climate, which makes autumn sowing essential, so that there is a very long growing-period. In addition, as the large-scale production of this material is new to Australia, much of the labour employed is inexperienced in this class of work. However, results obtained from investigations in this Laboratory indicate that, although the factors currently believed responsible for the differences between Australian and Belgian fibre are undoubtedly important, there are others, associated with the retting process, which are equally significant. This communication outlines the findings and shows that some Australian flax at least can yield much higher grade fibre than has been obtained to date.

Bacteriological studies have shown certain striking differences between the retting flora of Belgian- and Australian-grown flax. The bacteria active in the retting of the former straw were almost exclusively pigmented species of the genus *Clostridium*, the orange-pigmented *Cl. felsineum* predominating, with smaller numbers of an unidentified *Clostridium* forming a yellow pigment. These species have only been found in a few of about fifty Australian rets and, when present, formed only a small part of the retting flora. The retting bacteria most commonly found on Australian flax are: (1) a micro-aerophilic species related to *Cl. tertium* but differing from the latter in that it liquefies gelatin, and (2) an unidentified, strictly anaerobic *Clostridium* which forms characteristic colonies with a 'woolly' margin and a tendency to become embedded in agar media. Pure-culture tests on sterilized flax have demonstrated notable differences between the retting efficiencies of the four bacteria mentioned. *Cl. felsineum* causes rapid, complete retting and yields a clean, lustrous fibre. The yellow-pigmented species appears almost equally efficient. On the other hand, the strictly anaerobic *Clostridium* from Australian flax rets more slowly and less well, while the micro-aerophilic organism causes slow and incomplete retting.

Since *Cl. felsineum* was first isolated from hemp retting-pits by Carbone and Tombolato[1], it has been found active in flax retting, and its efficiency in this respect remarked on, by investigators in several countries, including Orla-Jensen and Kluyver[2], Markova[3], Ruschmann and Bartram[4] and Enebo[5]. From these reports and our own work, it is evident that, while several species of *Clostridium* are able to ret flax under anaerobic conditions, their abilities in this direction differ appreciably. Consequently, it may be concluded that the quality of the flax fibre produced will be considerably affected by the identity of the bacteria retting the straw, and I believe that the prevalence of *Cl. felsineum* is an important factor contributing to the consistently high quality of the fibre produced by Belgian retteries. Conversely, the infrequent occurrence of this *Clostridium* and the fact that less efficient retting agents predominate in the tanks probably contribute to the low quality of the fibre produced in Australia. In this connexion, it is of interest to recall that Allen[6] found the bacteria active in flax retting in England to be strains of *Cl. tertium*; he apparently did not encounter *Cl. felsineum* or other pigmented Clostridia. It therefore seems reasonable to assume that the quality of some English flax fibre may also be suffering because of the absence of the most efficient retting bacteria. Certainly, English fibre, while sometimes superior to Australian, falls short of Belgian standards.

The conclusions drawn above regarding the relationship between fibre quality and the retting flora are supported by the results of a test involving the processing of Australian and Belgian flax samples in both countries. The former flax gave much higher grades of fibre when retted and scutched in Belgium than when processed locally; but the latter yielded fibre of the same quality in both places. The fibre

Sample	Processing details	Fibre grade	Residual hemicellulose (%)
A	Single ret in Australia		
(1)	Scutched in Australia	*C* + ½	12·69
(2)	Scutched in Belgium	*D*	12·32
B	Retted and scutched in Belgium		
(1)	Single ret	*H*	10·95
(2)	Double ret	*K*	8·80

grade and residual hemicellulose content of the Australian samples are shown in the accompanying table.

It will be seen that Belgian scutching of Australian retted flax only improved the fibre by one half-grade, whereas Belgian single retting led to an improvement of four and a half grades, and there was a marked decrease in the hemicellulose content of the fibre with increasing grade. It is therefore evident that the higher quality of the Belgian-processed Australian flax is attributable to more complete retting. Why, then, did the Belgian flax yield the same grade of fibre in both countries? An explanation for this apparently anomalous result can be offered in the light of the bacteriological findings recorded above. When the Belgian flax was retted in this Laboratory (Australia), without admixture of other straw, the same retting bacteria, carried on the straw and comprising mainly *Cl. felsineum*, would be active as when it was retted in Belgium, so that the same grade of fibre could be expected in both places, provided that other steps in the processing, such as scutching, were comparable. On the other hand, the small sample of Australian flax sent to Belgium was retted in the same tank with a large quantity of Belgian flax, thereby being subjected to the action of the retting bacteria of the latter material, which would predominate in the tank and were presumably of a similar nature to that of the Belgian flax retted in Australia. As a result of the action of a more efficient retting flora, the full potential fibre quality of the Australian flax was realized. These results clearly support the contention that the quality of Australian flax fibre is adversely affected by the scarcity in our soils of the most efficient retting bacteria, and that at least some Australian-grown flax is potentially capable of yielding high-grade fibre.

Further confirmation of the belief that Australian flax would benefit by retting with *Cl. felsineum* has been forthcoming from a series of laboratory rets inoculated with cultures of this organism. In all cases, the inoculated rets were completed in little more than half the time required by the uninoculated, and the fibre from the former was noticeably superior to that from the latter in fineness, cleanness and lustre, with improvements ranging from one half to three grades. The degree of improvement resulting from inoculation of the rets was governed by the inherent fibre-strength of the flax samples. Some were weakened too much by the more severe retting for improved grades to be obtained, but the stronger types suffered no appreciable weakening and benefited greatly by the more complete removal of encrusting hemicellulosic material.

This work is being extended with the object of finding an economical method of introducing the more efficient retting bacteria, such as *Cl. felsineum*, into commercial retting in Australia. Should this be possible, a considerable improvement in the quality of much Australian-grown flax may be anticipated.

The work described is a part of the investigations being carried out by the Flax Research Laboratory of the Commonwealth Scientific and Industrial Research Organisation.

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THE WORLD'S FOOD AND BRITAIN'S NEEDS

THE Association of Scientific Workers held a conference in London during March 4–5, on "The World's Food and Britain's Needs". While some speakers provided the technical background of food supply from the land and sea and described the possibilities of pest control and new food preservation, Lord Boyd-Orr, Dr. Julian Huxley and Mr. F. Le Gros Clark gave overall surveys of the problem of supplying food to an ever-increasing world population desiring a rising standard of living. In all cases it was the supply of food which was discussed, not nutritional requirements, which were adequately dealt with in the British Medical Association's report published the day before.

Dr. Huxley started by giving a grim picture of the acceleration in world population, and pointed out that even if the *rate* of increases were declining (and it is not) there would still be net increases for some time to come. The decreasing population in Great Britain and some other Western European countries which alarmed us before the Second World War was a local phenomenon—and even in this area the tendency has since been reversed. We all know of the enormous population increases in the Far East (Formosa has doubled its population in less than thirty years; in 1872 Japan had 32 millions, now there are more than 80 millions), but few of us realize that Egypt has doubled its population during this century, and there are other equally startling figures.

Of the present world population of approximately 2,200 million (contrast 920 million for the year 1800 and only about 545 million for 1650), a half or two-thirds suffer from malnutrition. This means that, even without allowances for further population increases, a big increase in food production is needed. Why has food production not kept up with increases in population? Apart from the ravages of war, Dr. Huxley enumerated several cases of bad husbandry on a national level, such as the excessive tree felling in the Lebanon, Yugoslavia and Greece, the cultivation of steep slopes without suitable contouring, and allowing previously irrigated land to go back to arid desert. He said that the soil erosion on Haiti, with its 3½ million inhabitants on 10,000 square miles, must be seen to be believed.

Mr. Le Gros Clark hit hard at those who ask what is the use of saving thousands from malaria and other diseases in order that they may die of hunger. He insisted that nothing could hold back medical science, which is the pacemaker for agricultural science. Agriculture has the problem of increasing output fifty to a hundred times in the next fifty years, and, while medicine could save thousands of lives by sending a small band of trained men to clear an area of, say, malaria, despite the ignorance of the inhabitants themselves, on the other hand agriculture cannot be improved without the active co-operation of millions of backward peasants, "oppressed by all the evils which can oppress them". These evils must be swept away before we get the model producer we want. What is needed is an Agricultural Revolution changing farming methods and social relationships as profoundly as the Industrial Revolution changed our lives a hundred and fifty years ago.

In the opinion of Dr. Bunting, chief scientific officer of the Overseas Food Corporation, what is perfectly possible technically is impossible socially,

but Lord Boyd-Orr (whose address was read in his absence through illness) stressed that "there can be no social contentment or peace in the world so long as the majority of the people lack food and believe that under a new order they can get it".

Not only must the backward peasant be educated, but also the industrial worker must learn to play his part more fully. In his summing up on the second day of the conference, Mr. Le Gros Clark suggested to the delegate from the United Nations Educational, Scientific and Cultural Organisation (Mr. M. Goldsmith) that what is needed is not so much information about agricultural methods in different countries as stimulation of the industrial workers (90 per cent of the population of Great Britain) to consider better *their* possible contributions towards the improvement of methods and machinery of agriculture. This would not only be in the interests of agricultural communities, but also in our own. Despite the record of famines in India over the centuries, if India and Great Britain were both forced to stop importing food, the Indians would survive longer than we should.

Sunday morning was devoted to the specific problems of improving food production in Britain and of preventing loss of food through pest infestation.

Sir George Stapledon said it is foolish for us to let our wheat acreage fall below the three million mark and asserted that the East Anglian counties did not produce the wheat they should, even at the height of war-time effort. However, he warned, farming to the hilt depends on our obtaining sufficient phosphates and potash.

Dr. G. A. Reay, in talking on fish utilization (he was concerned only with marine fish and made no reference to freshwater fish), pointed out that freezing white fish at sea would mean a considerable saving of steaming time for boats, which often have to return half-empty in order that the fish already caught should not lose its freshness before consumption. Development of freezing plant would also help the canning of fish, as it would enable a constant supply of fish to be available, for no canning factory can work profitably if it only receives seasonal supplies.

Mr. S. A. Barnett, who is head of a research unit on mammalian pests in the Ministry of Agriculture and Fisheries, emphasized that for efficient pest control not only must the scientific worker study the natural history, that is, the life-cycle, habits, etc., of the pest, but also there must be an informed public. It is no use setting traps for rats in India while the Indians go round the traps releasing the caught rats. Not only co-operation between the scientific worker and the public is necessary, but also for many pests international control is essential. International study and control have already proved effective in combating the African red locust and the Colorado beetle, and are under way for the periodic plagues of field mice which occur in Europe and the Soviet Union.

The discussion after the main speeches was more concerned with the politico-ethical/social aspects than with purely technical problems. But the main speakers asked that various lines of research should be undertaken. Sir George Stapledon wanted research on the differential extraction power of different plants on different soils, regarding essential chemicals; Dr. Reay wanted engineers to tackle the problems connected with freezing fish at sea, and, finally, Mr. Le Gros Clark asked for a real study of the 'natural history' of famines. There are too many people willing to sacrifice themselves and their money on relieving famines which have already got out of hand, and there is not enough research into what leads up to a famine situation.

Lord Boyd-Orr appeared in Paul Rotha's film, "The World is Rich", which was shown at the opening of the proceedings, and Dr. D. McClean, of the Lister Institute, read the address he had prepared. He described how food shortages in the past have been responsible for revolutions and described how, in our day, the revolt against hunger and poverty in Asia has produced the most pressing political problem; but, "in a sane world", the enormous surpluses accumulating in one part of the world and the scarcity of food encouraging revolt in other parts *should* cancel out. Can we ensure that this world of ours *is* sane? The world food plan of the Food and Agriculture Organisation to double world food production in twenty-five years was put forward in 1946, but the world has not taken sufficient heed of it yet, and the end of Boyd-Orr's speech is worth quoting in full:

"The doubling of world food production would call for an enormous volume of industrial products, many schemes like the T.V.A., plans to stop soil erosion and recondition wastage soils, tractors and farm implements and vast quantities of consumer goods for the agricultural population. These constitute 65 per cent of the gainfully employed people of the world. With an assured market at a price at or near parity with industrial products, the purchasing power of food producers would be more than doubled. To carry out such a plan would require credits to countries to enable them to purchase the industrial equipment and to provide a world fund to ensure that everything produced could be sold. The World Bank was set up for that very purpose. If all nations were willing to co-operate in a great scheme of this kind of development of the potential resources of the earth and contribute to an international fund in proportion to their wealth, those having no money putting in an I.O.U. which would be honoured when their natural resources were developed, the world would be well on the way to the abolition of hunger, poverty and preventable diseases and to agricultural and economic prosperity with a doubling and redoubling of world trade. And most important of all, if the nations co-operated on definite concrete plans of benefit to all, the idealogical differences which separate nations would in time lose their significance."

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VICE-CHANCELLOR'S REPORT

THE vice-chancellor of the University of Birmingham, Sir Raymond Priestley, recently made his annual report to the Court of Governors, and among other matters of interest, he dealt with the relation between universities and technology. The Second World War revealed the comparative scarcity of highly trained technologists in Great Britain as compared with the United States and Germany. Since the War a deliberate assessment of Britain's needs in this respect has been or is being made. The earliest pronouncement was the Barlow Report, which broadly stated that the output of scientific workers from the universities should be doubled; last December the Ministry of Labour and National Service issued five pamphlets which dealt with the national need for physicists, chemists, geologists,

electrical engineers and architects (see *Nature*, January 28, p. 125). The forecasting of such needs in these times of instability and rapid change is not easy.

To-day, however, the chief preoccupation of those concerned with technical education in Great Britain is no longer how many exponents of higher technology are required, but where they should be educated. Broadly speaking, there are three schools of thought about this: many would have the top of the technical colleges strengthened to deal in greater measure with teaching of degree standard and the research that properly accompanies such teaching; others would prefer to see the broader fields of technological education attached to universities; and yet another school is in favour of the development of a few institutes of technology of the type already existing in the United States and on the Continent of Europe. Sir Raymond would be content to see experiments on all three lines. He is in favour of the establishment of a Royal Institute of Technology which, through associateships and fellowships of unquestionably high standard, should so foster higher technological education in the better technical colleges that the qualifications they give should, though of different scope and emphasis, be on terms with the first degree of a university and should rank for consideration for admission to university postgraduate courses in the same way as do honours degrees. It should, however, be borne in mind that the United States, with a population of 150 millions, only manages to support three such institutes of international reputation.

It should be very carefully considered whether it would be wise to isolate the higher technology from higher studies in other fields. The tendency in the American institutes of technology has been to reorientate their curriculum and include an increasing proportion of the 'humanities'. In fact, they have moved steadily towards becoming universities with a technological bias, but without the advantage of having that informed intercourse with students who have other disciplines as their main objectives. Liberal education can be achieved to some extent by the proper treatment of almost any specialist subject; but specialists will immerse themselves in their subjects, and some counterbalancing influence is essential. Such an influence is more easily and better secured through contact, outside the lecture room and laboratory, with fellow students studying other fields of human knowledge and activity than through the inclusion of a proportion of 'arts' subjects in the science curriculum.

As to the civic universities generally, they cannot retreat out of the world of which they are a part. Sir Raymond thinks the only solution is to keep a firm hold of the idea that there is a general corpus of fundamental knowledge with which every university must be concerned. Beyond this there are fields of applied knowledge vital to the welfare of a modern community in which teaching and research at the university level must be done. Each university should do its share according to its genius and its environment. A university strong in physics, mathematics and chemistry, as Birmingham is, may rightly develop engineering. From a good engineering faculty in a city famous for its light industries, a chair of production engineering might naturally arise, as it did in Birmingham.

The University Grants Committee has requested the University of Birmingham to consider the establishment of courses, similar to those in production engineering, in mechanical engineering (thermodynamics), metallurgy and chemical engineering. This the University will be glad to do, but two problems have to be solved. In the first place, the courses would be intended for those who have already spent some years in industry, most of them of mature age, some of them in established positions and many with wives and families. Such men would be returning to the University at a considerable financial sacrifice, and maintenance grants of £300–£450 would be required. Some, no doubt, would be financed by the firms for which they work, and others may be supported by grants from the Department of Scientific and Industrial Research, but some additional help will be required in many cases. Whatever the source of assistance, it would be a great convenience if its distribution were in the hands of the University. For the Department of Production Engineering funds have been provided by the generosity of Sir Peter Bennett, and it is hoped that, after the new courses have proved their value, a larger proportion of the sum will be maintained by the firms which they are serving or which hope to benefit from this development of technological education. Such an endowment might well appeal to friends of the University in the industrial world.

The second problem is that of living accommodation, and this at the present time is one of great difficulty. In the long run the proposed building of halls of residence may be expected to provide the solution, but the effect of devaluation of the pound sterling on the national capital-development programme has probably postponed this achievement for five years or more.

PACIFIC SCIENCE BOARD

ANNUAL REPORT FOR 1948

THE second annual report of the Pacific Science Board* covers the operations of the Board in 1948, but includes a brief account of the establishment of the Board and of the Pacific Science Conference at Washington, D.C., in June 1946. The Co-ordinated Investigation of Micronesian Anthropology continued, and the intensive field investigations of twenty-seven out of the forty-two participants were completed during the year. Final reports from the eleven participants have been accepted by the Board and will be published, where possible, in the regular scientific bulletins of the sponsoring institution or will be micrographed.

At the meeting in Honolulu on April 16, 1948, of the Insect Control Committee for Micronesia, the results were assessed of field work carried out in Malaya and the Palaus on the rhinoceros beetle (*Oryctes rhinoceros*); in Malaya, Java and the Marianas on the coco-nut beetle (*Brontispa mariana*), and in British East Africa and Zanzibar on the giant African snail (*Achatina fulica*). The programme for the year included the preparation of a comprehensive report on the giant snail, and an abstract of the results of all these studies was presented at the Seventh Pacific Science Congress in New Zealand. Follow-up reports on the effectiveness of the wasp *Scolia ruficornis* in control of the rhinoceros beetle in the Palaus are so far inconclusive. A conference on conservation in Micronesia, arranged in Honolulu by the Board, was followed by a similar conference in Washington, D.C. The recommendations of these two conferences,

* Pacific Science Board. Second Annual Report, 1948. Pp. 73. Washington, D.C.: National Research Council, 1949.)

which are summarized in this report, were published in a report, "Conservation in Micronesia", compiled by H. J. Coolidge, and they were transmitted to the Navy Department and the administrative authorities of the Trust Territory of the Pacific Islands. Later, the Pacific Science Board was requested to nominate a candidate for the post of conservation officer, and to organise an advisory committee. This has been done in two panels, one in Washington, D.C., and one in Honolulu.

The meeting on June 19, 1948, of the United States Committee on the Oceanography of the Pacific was concerned with the presentation at the Seventh Pacific Science Congress of the American contribution in this field. Reference is also made to the progress of the Pacific Oceanic Biology project, but while the report lists the American men of science who attended the Seventh Pacific Science Congress, a full account of that Congress is promised in the 1949 report of the Board. Among the advisory activities of the Board in 1948, the report stresses the close association of the Board with the Fulbright programme of the international exchange of personnel of the Conference Board of Associated Research Councils.

A total of 43,300,000 dollars was announced for research in the Pacific area, including five million for Australia, seven million for Netherlands East Indies, twenty million for China and 2,300,000 dollars for New Zealand, and some of the twenty million dollars announced for the United Kingdom and the five millions for France may be available for their Pacific Colonies. The Board was also consulted on matters concerning the scientific personnel and programme of the Research Council of the South Pacific Commission, and the executive secretary of the Board, as one of the two United States Government delegates to the Fontainebleau Conference, assisted in the establishment of the new International Union for the Protection of Nature.

LADY TATA MEMORIAL TRUST

THE Lady Tata Memorial Trust, founded in 1932 by the late Sir Dorabji Jamsetji Tata, of Bombay, in memory of his wife, the late Lady Tata, has published a report of the work done by its international section during the past fifteen years*. In this report is set out a summary of the work on leukæmia and other blood diseases which has been financially helped by the Trust during this period on the recommendation of its distinguished European scientific advisory committee.

About one-fifth of the income of the Trust is devoted each year to scholarships and prizes, which are awarded to Indian workers for research by them on any problem related to human suffering; the other four-fifths provides grants or scholarships which are open to persons of any nationality in any country for work on diseases of the blood, with special reference to leukæmia. The report shows that some twenty-nine workers in eleven different countries have been helped by the Trust, either by short-term grants or scholarships or by expenses grants for long-term programmes of work on the leukæmias at recognized centres. These long-term programmes have been assisted at the Department of Pathology, Cornell University Medical College, New York, under Prof. E. L. Opie and Prof. Jacob Furth; at the Institut du Cancer, Paris, under Prof. G. Roussy; and at the University of Copenhagen, under the late Prof. Oluf Thomsen and latterly under Prof. J. Engelbreth-Holm.

These long-term studies are summarized in this report, and Prof. Furth gives a valuable brief summary of our present knowledge of the leukæmias. Leukæmia behaves, he writes, as a neoplastic disease, and the availability of leukæmic animals in large numbers has made it possible to prove that leukæmia is "cancer of the blood-forming cells". Leukæmic cells are, however, not inherited as such, even by the mice of the leukæmic strain *Ak*, most members of which will die of leukæmia at the age of 7–11 months. At a few sites in the body, of which the lymphoid tissue in and around the thymus gland is one, normal cells become leukæmic a few weeks before signs of leukæmia are noted. These sites are determined largely by heredity, and there is evidence that the change is analogous to a somatic mutation. There is no evidence that the leukæmic change can be prevented, and the trend towards an increase in the incidence of leukæmia is likely to remain.

It has been known for some time that a virus-like agent causes leukæmia in fowls, and this, together with leukæmia in the rat, has been studied by Prof. Roussy and his colleagues. Prof. Roussy concludes that the same virus may cause either transmissible leukæmia or sarcoma of fowls; that considerable active immunization against fowl leukæmia is possible; that fowl leukæmia can occasionally be induced by carcinogenic hydrocarbons; and that the transplantable chloroma found in the rat has close affinities to human chloroma.

At the University of Copenhagen, Prof. Engelbreth-Holm and his colleagues have studied leukæmia of fowls and mice. They agree that fowl leukæmia is a true malignant tumour and that different types of fowl leukæmia can be produced by the same virus. This virus can also induce sarcoma. Their attempts to treat the disease by X-rays, hormones and chemotherapy failed, but a strong immunity could be produced in chicks by virus adsorbed to aluminium hydroxide. In ducks a powerful immune serum was produced by injection of blood from leukæmic fowls. Leukæmia in mice was accelerated by treatment with carcinogenic agents (X-rays, hydrocarbons), and the implications of this are discussed. Prof. Engelbreth-Holm's book, "Spontaneous and Experimental Leukæmia in Animals" (Edinburgh and London: Oliver and Boyd, Ltd., 1942) was written at the request of the scientific advisory committee of the Trust; it was smuggled out of Denmark during the earliest period of the German occupation and was then published under the authority of the Trust.

Workers helped by the Trust have studied karyoclastic drugs, such as urethane and nitrogen mustards, and have played their part in the development of folic acid and in work with radioactive isotopes, which can be used for the induction and treatment of leukæmia. Demographic studies of the disease, too, have been aided by the Trust, which has also helped to establish the Oxford Lymph-Node Registry. One has only to look through the list of grants given in this report to realize how broad and wise is the outlook of the scientific advisory committee. The help given has not been confined to the study of leukæmia, but has also included grants for work on the megaloblastic anæmias, tropical nutritional anæmia, the argentaffin cells of the alimentary tract and the effects of pterins on blood-formation.

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* Report on the Working of the Lady Tata Memorial Trust (International Section) from 1933 to 1947. Pp. iii+53. (Bombay: Lady Tata Memorial Trust, 1949.)

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Mechanism of Glyceraldehyde Inhibition of Glycolysis

THE effect of low concentrations of monomeric glyceraldehyde in inhibiting lactic acid formation in tissues using glucose but not in those using glycogen has been the subject of much experimentation and discussion. Stickland[1] used dialysed muscle extract, reinforced with yeast hexokinase, and studied both substrates with this system. 0·01–0·001 *M* glyceraldehyde caused 80–90 per cent inhibition with glucose but had little or no effect with glycogen. Stickland found (private communication) by special tests that glyceraldehyde was not inhibiting hexokinase in this system.

After the discovery by Warburg and Christian[2] and by Caputto and Dixon[3] that glyceraldehyde is a substrate for the triosephosphate dehydrogenase of yeast and of muscle, but oxidized much more slowly than glyceraldehydephosphate (at about one three-hundredth of the rate in the case of muscle), it seemed possible that glyceraldehyde might interfere with glycolysis by competing with glyceraldehydephosphate for the enzyme. In the system used by Stickland (and in tissues also) glycolysis depends on repeated rephosphorylation of adenosine diphosphate and adenylic acid formed; with glucose as substrate, the need for this rephosphorylation is twice as great as with glycogen. A factor, such as inhibition of triosephosphate dehydrogenase, interfering with this process will have the effect of diminishing or stopping the initial phosphorylation of glucose. Two lines of work were followed in testing this hypothesis.

(1) Using crystalline triosephosphate dehydrogenase. The activity of the enzyme was tested in a system containing pyrophosphate buffer, arsenate, glyceraldehydephosphate (0·0006 *M*) and co-enzyme I, the rate of formation of reduced co-enzyme being followed in the Beckmann spectrophotometer. With 0·006 *M* glyceraldehyde the inhibition was about 30 per cent. The triosephosphate dehydrogenase was greatly activated by addition of 0·006 *M* cystein. Under these conditions the inhibition by glyceraldehyde was much greater—about 85 per cent by 0·006 *M*. The experiments so far considered were done with DL-glyceraldehyde; when this was compared with D-glyceraldehyde, it was found that the inhibition was to be attributed to the latter component. Increased concentration of glyceraldehydephosphate led to diminished inhibition.

(2) Using the same system as Stickland. (*a*) It was shown that upon addition of 0·0005 *M* iodoacetate (to which triosephosphate dehydrogenase is known to be the most sensitive of the muscle enzymes) a condition was established in which glucose breakdown was greatly inhibited, whereas glycogen breakdown was little affected; (*b*) the inhibition by 0·0025 *M* glyceraldehyde, coming on about 8 min. after its addition, can be postponed for another 12 or 15 min. if extra triosephosphate dehydrogenase (in the form of the pure enzyme) is added to the system; (*c*) the inhibition can be prevented by addition of extra co-enzyme I (final concentration about 0·0003 *M*). The possible significance of this fact and of the prevention of inhibition by addition of traces of pyruvate[4,1] will be considered elsewhere; (*d*) inhibition was greater with D-glyceraldehyde than with an equivalent amount of DL-glyceraldehyde.

When this work was nearing completion, a paper by Rudney[5] appeared, describing the inhibition (60–80 per cent) of hexokinase activity in tissue slices and extracts by 0·004–0·001 *M* DL-glyceraldehyde. This inhibition (like the inhibition of glucose glycolysis in 4½-day chick embryos described by J. Needham and Lehmann[6] and in tumour tissue by Mendel *et al.*[7]) was not caused by D-glyceraldehyde and must be put down to the L-component.

Using rat muscle extract, we have confirmed Rudney's results under the conditions used by him (final concentration of glucose 0·043 per cent). It was found, however, that inhibition became progressively less with increasing glucose concentration, disappearing at about 0·11 per cent glucose with 0·0025 *M* glyceraldehyde. Since the glucose concentration in the system used by Stickland was about 0·32 per cent, the absence of hexokinase inhibition here is readily understood.

It is to be concluded that the inhibitory effect of DL-glyceraldehyde upon glycolysis in tissue slices and extracts depends upon more than one mechanism and will vary with conditions; one factor will be the concentration of glucose and of glyceraldehydephosphate at the hexokinase and triosephosphate dehydrogenase surfaces respectively. It remains a possibility that both D- and L-glyceraldehyde inhibit other enzymes; we found indications that glycerolphosphate dehydrogenase is also inhibited by D-glyceraldehyde.

These results will be described in detail elsewhere.

We are deeply indebted to the late M. Louis Rapkine for the benefit of much discussion; our sincere thanks are due to Mlle. Bianca Tchubar, who made much of the glyceraldehydephosphate used, and to Mr. B. C. Loughman for the preparation of the D-glyceraldehyde.

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Distribution of Protein in the Tissues of Rats Treated with Anterior-Pituitary Growth-Hormone

RATS treated with growth-promoting anterior-pituitary extracts[1] or with purified pituitary growth-hormone[2] gain more body-weight than pair-fed control animals. In experiments with rats, cats and dogs fed a constant amount of food throughout the experiment, Young[3] found that diabetogenic growth-promoting anterior-pituitary extract induced a substantial rise in body-weight even when, as with the

Growth in the Tissues of Pituitary-treated Pair-fed Rats

	Number of rats	Liver	Heart	Vastus lateralis	Gastrocnemius	Diaphragm	Digastric
			(a) Total weight of fresh tissue (gm.)				
Control	6	7·75 ± 0·29	0·80 ± 0·07	1·74 ± 0·05	0·41 ± 0·02	0·40 ± 0·02	0·045 ± 0·002
Treated	6	8·79 ± 0·36	0·82 ± 0·06	2·33 ± 0·05	0·47 ± 0·01	0·57 ± 0·01	0·057 ± 0·001
Fisher's *P*		0·059	0·835	<0·001	0·031	<0·001	0·002
		(b) Total nitrogen content of organs expressed in terms of mgm. of nitrogen/100 gm. body-weight					
Control	6	131·3 ± 4·1	11·71 ± 0·62	29·59 ± 0·61	7·31 ± 0·33	5·81 ± 0·20	0·77 ± 0·06
Treated	6	128·8 ± 2·4	10·74 ± 0·55	34·64 ± 0·74	7·32 ± 0·20	7·47 ± 0·14	0·86 ± 0·02
Fisher's *P*		0·595	0·917	<0·001	0·985	<0·001	0·201

(The results given are mean values for each group together with the standard errors of the mean values.)

dog and the cat, a severely diabetic condition simultaneously developed. In all these investigations evidence was adduced to show that the rise in body-weight in the pituitary-treated animals resulted mainly from a deposition of protein-containing tissue. The present experiments were designed to indicate the site of the protein deposited in the bodies of pair-fed rats treated with purified pituitary growth-hormone.

In a typical experiment a group of adult female rats were treated daily by subcutaneous injection with 1 mgm. of pituitary growth-hormone prepared by the method of Wilhelmi *et al.*[4], the control group receiving an appropriate volume of subcutaneous saline. The daily food consumption of each treated rat was so adjusted that it was the same as that of its control partner. After twenty-three days the animals were killed and the quantitatively isolated tissues weighed and analysed. The accompanying table gives analytical figures for such an experiment but does not include the figures for the nitrogen content of the tissues expressed in terms of the percentage weight of the wet tissue, since no significant difference in this respect was observed between the experimental and the control animals. In this particular experiment the control rats added an amount equal to 2·2 ± 1·1 per cent of their initial body-weight during the period of the experiment, while the identically fed pituitary-treated animals added 15·6 ± 1·6 per cent to theirs. The figures for the gross weight of the organs and tissues (see table) show that, of those studied, only the heart of the pituitary-treated animals failed to increase in weight, though the liver, kidney and spleen rose in weight only a little.

Since the major part of the nitrogen in tissues is present in the form of protein, and since the total amount of protein present in the various organs may be taken as an indication of their growth, the data for the total nitrogen present in each type of organ were expressed in terms of gm. of nitrogen in the whole organ per 100 gm. of body-weight. When these results are examined (see table) apparently capricious differences in the behaviour of the various tissues are revealed. Thus, as might be expected, most of the tissues which serve the body as a whole grew at the same rate as the body; that is, they exhibited isometric growth. This was true of many, but not all, of the skeletal muscles, which in some instances grew much faster than did the body as a whole, the differences being highly significant statistically.

The results of a series of experiments of this type have shown that, in the pituitary-treated rat, the growth of the following organs is nearly isometric with body-growth: liver, kidney, spleen, uterus and heart; this is also true of the following skeletal muscles: gastrocnemius, soleus, tibialis anterior and the digastric. On the other hand, the following muscles grow significantly faster than does the body as a whole: diaphragm, pectoralis major, masseter, vastus lateralis, acromiotrapezius, supraspinatus, and the deep muscle of the spinal cord.

Consideration of the nature of the muscles studied does not reveal any obvious anatomical, histological or functional explanation of the fact that some muscles grow only at the same pace as the body in general, while others grow at a substantially greater rate. The fact that, in the rat, pituitary-induced growth affects some organs so strikingly while leaving others unchanged may well be of importance in the examination of the enzymic mechanisms involved in such growth.

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Riboflavin of Sow's Milk

Braude *et al.*[1,2] studied at Reading the vitamin content of colostrum and milk of Large White sows and obtained values for riboflavin around 0·5 μgm./ml., that is, some three to four times less than in cow's milk. They were admittedly surprised by such relatively low concentrations in the milk of an animal the young of which grow at a very rapid rate. The chemical method for riboflavin was that proved suitable for its measurement in cow's milk (Henry *et al.*[3]). Moreover, the observation of Braude *et al.*[2] that vitamin C in sow's milk and colostrum was relatively little affected by exposure to light supported the low analytical values for riboflavin, which is known to act as catalyst in the photochemical destruction of vitamin C [4].

In similar work at Stillwater, milk samples were obtained from thirty-four sows of Hampshire, Duroc and Chester White breeding of the Oklahoma Agricultural Experiment Station experimental herd during the spring and autumn farrowing periods in 1948. The sows were maintained in concrete pens upon rations adequate for reproduction and lactation with respect to known nutrients but composed of material of plant origin and possibly deficient in 'animal protein factor'; certain lots received supplementation with small amounts of materials rich in this factor. Colostrum samples were obtained by manual expression from the mammary gland during parturition;

milk samples were obtained in the same manner on the fifth, fifteenth and fifty-fifth days of lactation following the intravenous injection of 1–2 ml. of the oxytocic principle of the pituitary ('Pitocin', Parke Davis and Co.). The samples were frozen and maintained at − 15° C. until analysed. Microbiological analysis for riboflavin was performed on the whole colostrum or milk diluted to the proper concentration with water, using *Lactobacillus casei* (American Type Culture Collection No. 7469) as the test organism and a basal medium similar to that of Snell and Strong[5]. Duplicate determinations were made and each sample was assayed at five levels. Average results for all sows for both farrowing times are presented in Table 1. Statistical examination of the data by the method of variance failed to reveal any significant differences in the riboflavin content due to farrowing date, breed, or supplementation with 'animal protein factor' carriers; but all values were markedly higher than those reported by Braude *et al.*[1,2].

Table 1. RIBOFLAVIN CONTENT (μgm./ml.) OF SOW'S COLOSTRUM AND MILK, MEASURED MICROBIOLOGICALLY AT STILLWATER, OKLAHOMA, IN SPRING AND AUTUMN, 1948

Sample	Sows, spring farrowing	Gilts, autumn farrowing	Sows, autumn farrowing
Colostrum	6·5	3·4	4·7
Milk, 5th day of lactation	2·7	1·5	1·6
Milk, 15th day of lactation	2·2	2·2	2·2
Milk, 55th day of lactation	3·3	3·0	3·2

These findings were communicated to the Reading workers, who then tested for riboflavin chemically, microbiologically, and biologically with chicks and rats, a bulked freeze-dried sample of 15 litres of milk obtained from a number of sows, mainly of the Large White breed. All results were calculated back to the original milk; tests showed that there was no loss of riboflavin in freeze-drying. The chemical value by the method of Emmerie[6] used by Braude *et al.*[1,2] was 0·4 μgm./ml. The microbiological tests were done by a method essentially similar to that used at Stillwater and also by a method similar to that of Kornberg, Langdon and Cheldelin[7] using *Leuconostoc mesenteroides* (American Type Culture Collection No. 10,100), and yielded values of 1·5 and 1·2 μgm./ml. respectively. The chick tests[8] with groups of fourteen birds gave a value of 1·5 μgm./ml. with true fiducial limits at $P = 0.95$ of 1·2 and 1·8 gm./ml. The rat tests (Henry *et al.*[3]) with groups of 10 male rats (three groups for the standard, two for the unknown) gave similarly a value of 1·8 μgm./ml. with limits of 1·6 and 2·0 μgm./ml.

It thus became obvious that the rapid and simple methanol extraction method of Emmerie[6] used by Braude *et al.*[1,2] for the determination of riboflavin was unsuitable for sow's milk and colostrum, and that the values quoted by them were much too low.

Further work at Reading showed that more drastic extraction of sow's milk by heating in the presence of sulphuric acid at *p*H 1 for 1 hr. in a boiling-water bath, followed by incubation with taka-diastase for 2 hr. at 37° C. and *p*H 4·5 and by subsequent treatment of the extract according to Slater and Morell[9], yielded the same low results. However, if the last purification step was omitted, the results were much higher, most probably because part of the riboflavin was still present in the aqueous phase in a form not readily extracted by the butanol–pyridine mixture. In fact, the watery layer still showed yellow fluorescence in ultra-violet light after the purification procedure. Finally, with the method of Bessey *et al.*[10] the chemical value approached the microbiological value (Table 2).

Table 2. RIBOFLAVIN CONTENT (μgm./ml.) OF SOW'S MILK MEASURED AT READING BY DIFFERENT METHODS

Milk examined	Acid extraction and taka-diastase treatment			
	Methanol extraction	Direct measurement	Measurement after purification (Slater and Morell[9])	Method of Bessey *et al.*[10]
Sow's, freeze-dried, reconstituted	0·4	0·9	0·5	1·1
Cow's	1·1	1·1	0·9	1·3

It seems clear that riboflavin is present in sow's milk at least partly in a form different from those in cow's milk, and that the riboflavin activity of sow's milk is much higher than originally reported by Braude *et al.*[1,2].

Further work independently in progress in both laboratories should show whether the riboflavin content of sow's milk in England is similar to that reported in this communication for American conditions, or whether differences in breed, feeding and management are reflected in the level.

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Enzymic Oxidation of Proteins and the Enzymic Inactivation of Insulin

THE important communication of Drs. Sizer, Brindley and Wagley[1], at the First International Congress of Biochemistry held at Cambridge, the abstract of which I have only recently seen, makes it necessary for me to record that I have been working on almost identical lines. My results are in complete accordance with theirs.

Working with polyphenol-oxidase of potato plus traces of catechol (Dr. Sizer and his colleagues used mushroom 'tyrosinase' plus an activator) I succeeded in oxidizing the phenolic groups of insulin and of certain globulins of horse plasma and serum, which are precipitated between 0·25 and 0·50 saturation

of neutral ammonium sulphate. The globulins precipitated between 0 and 0·25 saturation and the albumins of the same origin, caseine and egg-albumin, are apparently not oxidized by the same system.

Insulin oxidized by this enzyme system (better by the *o*-quinone, which is the first oxidation product of the real substrate, which is the *o*-dihydroxy-phenol 'activator'[2,3]) is completely inactivated (see also note below).

This new reaction is of obvious importance for biochemistry and immunology. Its possible physiological importance in the case of the inactivation of insulin by an enzyme plus an *o*-dihydroxy-phenol analogue of adrenalin is already self-evident.

Details of this work will be published elsewhere.

I wish to thank Prof. J. Roche, of the Collège de France at Paris and president of the Institut des Hautes Études at Tunis, Dr. M. Uzan, director of the Physiological Laboratory, and Dr. L. Sassi, former director of the Chemical Laboratory of the same Institute, for their hospitality. Thanks are due to Dr. L. Balozet, director of the Pasteur Institut of Tunis, for the gift of horse plasma and serum.

Note added in proof. Shortly after submitting this letter I obtained direct experimental evidence in favour of this thesis—criticized by Nelson and Dawson[4]—by making polyphenol-oxidase act on insulin through a 'Cellophane' membrane. In this arrangement the added *o*-dihydroxyphenol activator (adrenalin) is oxidized by the enzyme on one side of the membrane and reduced back by the 'substrate' on the other side; but enzyme and its apparent substrate are never in contact.

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Retinal Oxygen Supply and Macular Pigmentation

In a recent letter, Dartnall and Thomson[1] suggest that because blood-vessels are absent from the macular region of the human retina, this area might be expected to suffer from a relative anoxia compared to the rest of the retina. Since this is certainly not the case, they suggest that the yellow macular pigment may supply a secondary oxygen-carrying system.

There seems to be no good reason for supposing that the absence of vessels in this region would result in any lack of oxygen supply to the foveal end-organs or their synapses. The inner layers of the retina (bipolar cells, ganglion cells and fibre layers) are dependent on the retinal circulation for their blood supply, but the visual end-organs (rods and cones) derive their nourishment from the choroidal blood-vessels. At the fovea the normal spatial relationship between the cones and the choroidal circulation is not altered, and, although the retinal vessels are displaced from the central area, so are the bipolar and ganglion cells connected to the foveal cones.

Dartnall and Thomson quote two investigations in which sparing of central vision was found under conditions of general anoxæmia and imply that these results support their hypothesis as to the function of the macular pigment. But in both the cases quoted the unaffected area was much larger than that which contains macular pigment; Evans and McFarland[2] found that central vision was spared for about 8–10° and Livingston[3] for well over 20°.

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Dr. M. H. Pirenne and Mr. E. J. Denton[1], Prof. H. Hartridge[2] and Dr. K. Tansley (above) have produced criticisms of our recent suggestion[3] that the macular pigment may play a part in supplying oxygen to the foveal region of the retina. Our replies to the main points in their criticisms are as follows.

(1) *That the macular pigment is produced by a post-mortem or pathological process and does not exist in the living healthy retina* (H. H.). This is an old point of controversy. Our belief in the existence of the macular pigment in the normal eye is based principally on Wald's recent work[4]. By subtracting the logarithm of the sensitivity curve for the macular region from that for an extra-macular region, Wald has produced a curve which, except in so far as it is complicated by any sensory differences that may exist between the two regions, gives the optical density of the macular pigment in the living eye. His results show that the density of the macular pigment *in vivo* varies with wave-length in much the same way as do the macular extracts of postmortem eyes.

Wright's method[5] of presenting the colour mixture data, so far from excluding the effect of pre-retinal pigmentation upon the measurements as Prof. Hartridge suggests, enables one to separate the effects of varying pigmentation from differences in the sensitivity of the retinal mechanisms. Thus mechanism variation affects the values obtained for the spectral coefficients, and pigment variation affects the position in the colour diagram of the white points. Pigment, in this context, denotes total pre-retinal pigment and includes lens as well as macular pigmentation.

Prof. Keilin has kindly directed our attention to an observation made by Dr. Smith and himself[6] in 1939. Examination of a continuous spectrum in a low-dispersion spectroscope revealed two diffuse absorption bands at 495 mμ and 455 mμ. They suggested that this phenomenon is due to the presence, probably in the macula and fovea, of either a flavin or a carotinoid or a mixture. They also noted that the two depressions detected by Gibson and Tyndall[7] in the spectral sensitivity curve of the eye occurred at similar wave-lengths.

The cause of 'fading' in the 'purple field' experiment, mentioned by Prof. Hartridge, is, in our opinion, the same as that which causes the shadows of the retinal vessels, demonstrable for a short time by oblique illumination, to 'fade'; namely, an adaptational change.

(2) *That there is no correlation between the extent of yellow pigmentation, the area lacking in blood vessels and the visual angle of spared vision in anoxia* (M. H. P. and E. J. D., and K. T.). One of us (L. C. T.) has obtained evidence[8] from a detailed examination of foveal spectral sensitivity data which

supports Wald's contention that the macular pigment is similar in light-absorbing properties to leaf xanthophyll. The spectral-sensitivity curve has local depressions corresponding in the blue and violet to the positions of the maxima of absorption in the trident-like spectrum of leaf xanthophyll. When the sensitivity is measured on the foveal slopes (60′ from the centre) the depressions are less obvious, indicating that here the concentration of the pigment is less. This state of affairs is contrary to that described by Polyak[9], but is in keeping with classical ideas on the distribution of the macular pigment and with our original hypothesis.

(3) *That because there is a prolific choroidal blood supply at the site of the central fovea one would not expect this region to suffer from an oxygen lack* (all critics). However prolific the choroidal blood supply may be, indeed even if the choroid presented a solid wall of blood, there is still the gap between it and the receptors across which the oxygen must diffuse: a gap which cannot be reduced by vasodilation. The withdrawal of a supporting oxygen pressure in the capillaries of the retinal system of vessels can only aggravate any deficiencies there may be in the supply of oxygen from the choroid. Indeed, the greater vascularization of the choroid at the fovea might be a natural reaction to a tendency there towards anoxic conditions.

(4) *That oxidation-reduction systems do not raise the oxygen tension but only enable the oxygen which is available to be used with greater efficiency* (H. H.) This is surely 'a distinction without a difference'. Of course, all oxygen supply is ultimately from the blood. The existence of a local oxidation-reduction system, by enabling the oxygen available to be used with greater efficiency, is tantamount to raising the *effective* oxygen tension at the cell. Our original suggestion rests upon the assumption that (in the absence of an oxygen-carrying system) the diffusion of oxygen from the blood to the receptors (not the carriage of oxygen to the retina by the blood) is the factor limiting the quantity of oxygen delivered to the cells. Thus in the periphery a fall of the partial pressure of oxygen in the blood reduces the diffusion pressure gradient from blood to cells and enables the restricting influence of diffusion to make itself felt; but at the centre, owing to the replacement of the diffusion system by an oxygen-carrying mechanism, no such restriction occurs.

(5) *That the function of the macular pigment is that of absorbing the blue and violet rays and so reducing the disturbing influence of chromatic aberration* (M. H. P. and E. J. D.). This is, of course, a possible explanation of the existence of the macular pigment, and, moreover, there is no need to regard it as an excluding alternative to the one we put forward. It should be remembered, however, that the lens pigmentation results in a marked diminution of the intensity of light in the blue and violet which reaches the retina. The purpose of this pigmentation is obscure since it steadily increases with age, but it may help to reduce chromatic aberration.

(6) *That the real cause of the sparing of the central area in anoxia is the relative shortness of the nerve fibres supplying the fovea* (H. H.). Since the source of the nerve fibres is the optic nerve, then, if this argument were true, the area of vision spared in anoxia should be centred around the blind spot, not the fovea.

(7) *That the presence of the yellow pigment does not account for tritanopia of the fovea* (H. H.). We regret an oversight in our original letter which should have indicated that the tritanopia of the fovea is ascribable *partly* to the yellow pigment and *partly* to the mechanisms of the fovea. Indeed, by measuring the dichromatic coefficients at three foveal positions, Thomson and Wright[10] demonstrated that mechanism differences exist even within the foveal area, and that these differences could not be wholly explained by differences in the degree of macular pigmentation.

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Chemical Estimation of Urinary Cortin

In view of the dramatic success of the application of certain hormones of the adrenal cortex (for example, Compound E) to the treatment of arthritis, methods for the estimation of these hormones and their metabolites have become of increasing importance. In this Laboratory we have been interested in the appraisal of adrenal cortical function in various other clinical conditions and have evolved an improved method for the chemical assay of urinary 'cortin'.

Of the published methods tested, that of Daughaday *et al.*[1] showed most promise; but it was necessary to effect an improvement with regard to reproducibility and sensitivity[2]. The original method is based on the liberation of formaldehyde by periodate oxidation of the α-ketol side-chain typical of this group of steroids, and the most significant improvements introduced by us were (*a*) in the exhaustive distillation and recovery of the liberated formaldehyde and (*b*) in the evaporation of the distillate in order to produce a satisfactory concentration for colorimetry, whereby recoveries of 90 per cent have been consistently obtained.

However, a less laborious method was found in the Conway diffusion technique[3], which had already been used for the estimation of acetaldehyde[4]. By an appropriate choice of solvents and of volumes employed, it was found possible to carry out both the oxidation and diffusion steps simultaneously in a standard Conway unit (supplied by Gallenkamp and Co., Ltd., London), absorbing the liberated formaldehyde in a sodium sulphite solution in the centre chamber. The hormone extract is contained in ethanol and oxidized by periodic acid in the outer chamber. Owing to the very slow rate of diffusion, calibration experiments were performed for formaldehyde recovery, and time-recovery curves were plotted for various temperatures using benzoyl carbinol as a standard formaldehyde-liberating substance. As it has been found that neither temperature nor time is very critical, diffusion is allowed to proceed at 20° ± 2° C. for four to six days, resulting in a calibration curve which is nearly flat at recoveries between 50 and 60 per cent, and one which covers the

concentration range normally met with in routine assays. This technique gives an even greater sensitivity than the modified distillation method, since the ultimate concentration of formaldehyde is greater than is readily obtained by that technique; thus it allows of the estimation of formaldehyde-liberating substances in the equivalent of only 40 c.c. of normal urine or 4 c.c. plasma.

We are at present investigating the possibility of using the smaller micro-units of Conway, and, if comparable recoveries can be obtained, it will then be possible, with the aid of a standard Spekker-micro attachment, to measure quantities of cortical steroids of the order of 5 μgm.

As criteria of specificity the following may be noted: (*a*) the periodate oxidation itself offers a fair degree of specificity; (*b*) 17-hydroxycorticosterone is recovered quantitatively from acidulated water by our modification of Daughaday's method; (*c*) we have found that the increase (more than 800 per cent) in cortin excreted by a woman injected with 35 mgm. of adrenocorticotrophic hormone per day for seven days corresponded with all the other criteria of adrenal cortical function studied (at the Rheumatism Research Centre, Manchester Royal Infirmary).

A controversial point concerns the effect of allowing urine to stand at *p*H 1 for one to two days before commencing extraction. Acid digestion has been successfully employed by Mason and Sprague[5] in their isolation of 17-hydroxycorticosterone from the urine of a boy with adrenal cortical hyperplasia, and we have always noticed a slight increase in urinary titres when employing this procedure. On the other hand, 17-hydroxycorticosterone may comprise only a fraction of the formaldehyde-liberating substances normally present in urine, as suggested by the slower rate of periodate oxidation of urinary extracts, and by the wide discrepancy between the values obtained by bio-assay and by chemical assay. It may well be, therefore, that on acid digestion some formaldehyde-liberating substances are destroyed, whereas others are generated, and that the majority of the substances included in chemical assay are acid-stable, biologically inactive metabolites the estimation of which gives a more accurate picture of adrenal function than bio-assay.

Finally, it is interesting to note that, even without acid digestion, our average normal values (1·5–2·5 mgm./24 hr.) are much higher than those of American workers. In this we are in accord with Dr. C. L. Cope, of the Postgraduate Medical School of London, who employs a copper reduction method.

We desire to record our indebtedness to Prof. Reichstein for the gift of 17-hydroxycorticosterone; Mr. E. Houghton and Dr. W. M. Dale for an introduction to the Conway technique; Dr. C. L. Cope for an interesting discussion; and the Medical Research Council for a research studentship (to G. T. B.) during the tenure of which this work was carried out.

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Determination of the Energy of High-Energy γ-Rays by the Photographic Method

Observations of the tracks of electron–positron 'pairs', produced by the passage of γ-radiation through photographic emulsions, have been described recently by Coates and Herz[1]. By measuring the energy of the particles of a given pair by the scattering method[2,3], in those cases in which the two trajectories are of sufficient length, it is possible to determine the quantum energy of the γ-rays.

We have recently employed this method to study the radiation produced by a synchrotron. Electron-sensitive emulsions were enclosed in a thin light-tight envelope, and were placed in the beam of radiation produced by the machine, at a distance of one metre from the target and with the plane of the plate parallel to the axis of the beam. The synchrotron was operated to give quanta with a maximum energy of 23 MeV., and 'soft' radiation was reduced in intensity by shields of copper and aluminium ¼ in. thick. The plates were subjected to an exposure of 10^{-2} R., as measured by ionization chambers.

After processing the plates, the tracks of large numbers of 'pairs' were observed under the microscope; but the measurements were confined to those examples in which the two tracks of a pair were each of greater length than 1 mm. In determining the energy of the particles by the scattering method, the directions of the projection of the track were measured at successive points 50 μ apart, by means of a protractor eyepiece. The energy was then deduced from the average value of the angular deviations by the methods described by Davies *et al.*[3].

The distribution in the values of the total energy of fifty pairs as determined by the above methods is shown in Fig. 1. This distribution cannot be regarded as representing the spectrum of the γ-radiation, because particles of lower energy will tend to be 'lost' through the effects of scattering. It is therefore due only to the high energy end of the emitted spectrum. The observed width of the peak is due partly to errors, associated with statistical fluctuations, inherent in the method[3]. Fig. 2*a* shows the distribution in the values of θ_{sep}, the angular separation between the two components of a pair; and Fig. 2*b* the values of θ_{dev}, the inclination of the bisector of the angle of each pair from the line of motion of the original quantum producing it. The quantity θ_{dev} appears to be more characteristic of the quantum energy of the γ-radiation than θ_{sep}.

The measurements shown in Fig. 1 prove that the photographic method can be employed to determine the intensity and the spectral distribution of γ-radiation. Experiments are now in progress, in collaboration with Mr. Hooper of this Laboratory, in which the method is applied to the measurement of the energy

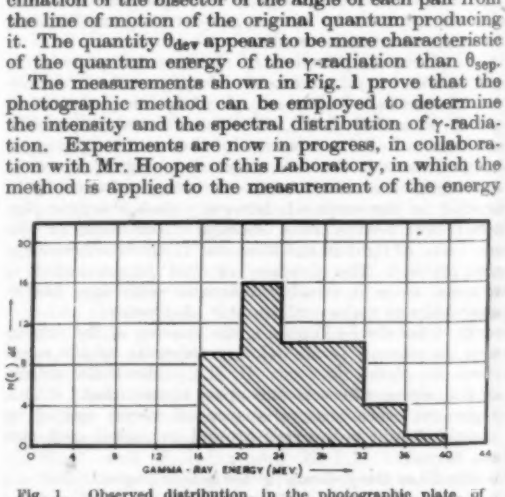

Fig. 1. Observed distribution, in the photographic plate, of quantum energies from the synchrotron

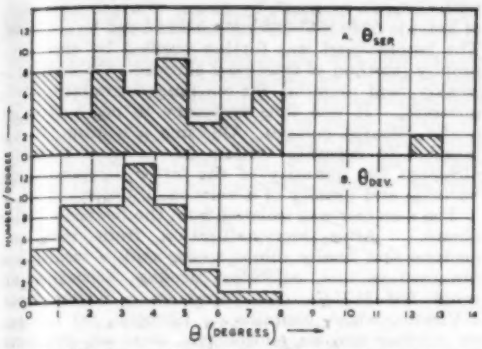

Fig. 2. The observed distributions of: (*a*) $\theta_{sep.}$, angle between the two tracks of a pair at the origin; (*b*) $\theta_{dev.}$, inclination of the bisector of the pair to the beam direction

of the γ-rays observed in the cosmic radiation at great altitudes. A comparison of the intensity and the energy distribution of this radiation with the corresponding quantities for the π-mesons observed to be created in the same plates, as 'shower' particles, is of great interest because of its bearing on the problem of the origin of the 'soft' component; and, in particular, in connexion with the possibility that the latter arises through the decay of short-lived neutral mesons into γ-rays.

I am indebted to Dr. F. E. K. Goward, of the Ministry of Supply, who made the exposure to the synchrotron, to Dr. R. H. Herz, of Messrs. Kodak, Ltd., who provided the plate, and to Prof. C. F. Powell for much helpful discussion.

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Ultra-Sensitive Portable Gamma-Ray Spectrometer

IT is the purpose of this note to report the construction of a new type of portable detector of the crystal variety, which has been operated with considerable success in northern Canada during the summer of 1949 in the search for uranium. A crystal of approximately 100 gm. is used as the gamma-sensitive scintillation element and, with an integration time for counting of a few seconds, a detection sensitivity of 10^{-16} R./sec. has been achieved. The use of miniature hearing-aid components has been employed to keep the weight of the complete unit down to 8 lb. Details will be published later. However, one noteworthy feature of the device is its operation as a 'proportional' counter or crude gamma-ray spectrometer, in the sense that the differential pulse height distribution gives a measure of the energies of the gamma-rays[1]. Photo-electron conversion lines and Compton recoil 'edges' are employed to identify these energies. In particular, thorium is easily identified by the Compton recoils due to the strong 2·62 MeV. gamma-ray.

Two complete instruments were operated in the Lake Athabaska and Black Lake districts of northern Saskatchewan for a period of two months, during which time some hundreds of miles of rugged country were traversed and several complete radiation surveys were made of known and hitherto unknown radioactive deposits. The instruments behaved in a completely satisfactory manner with regard to stability and sensitivity, and it was found possible to detect substantial deposits of uranium ore at distances of several hundred feet. The method employed in the investigation was to draw radiation contour maps using lines of equal gamma-ray intensity or 'isorads'. In this way the surface distribution of intensity could be adequately represented and the relationships of the various geological features made more clear.

In some cases extremely complex patterns of active shear zones, bedding planes, and cross-fractures were found. We were able, on more than one occasion, to compare the surface distribution of activity with the distribution of radioactive materials which was found after the removal of overburden. Anomalies in the relations of the two distributions were attributed to the emanating power of the ore body itself and the consequent diffusion of radon to the surrounding rock or soil. The relative contribution of cosmic-ray particles to the total counting-rate, several hundred thousand counts per minute in active areas, was found to be quite small. This was verified by aeroplane flights some of which showed convincingly the feasibility of using this method of detection for radioactive prospecting from the air. We have assured ourselves, also, that we have an instrument of value for the rapid investigation of geological formations and rock contacts, as determined by changes in trace quantities of radioactive materials. Relatively high readings are obtained over granite and acid rocks and, of course, over pegmatite intrusions.

The ultimate significance in civil defence of extremely sensitive detectors of the type we have been using is not difficult to appreciate.

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A New Type of Lattice with Large Periods in Silk

SINCE writing the communication entitled "An Unstable Lattice in Silk Fibroin"[1], a further modification of silk has been found which can be prepared by treating 'silk II' with 0·5 per cent sodium hydroxide at 60–70° C. for about a minute. We suggest that this new type of silk be called 'silk III'. It shows all the interferences of 'silk II' and in addition the equator net-plane distances shown in the accompanying table.

8·9 A. (medium)	23 A. (weak)
11 ,, (weak)	31 ,, (extremely weak)?
15 ,, (medium)	45 ,, (very strong)

From X-ray investigations of 'higher oriented' samples[2], it seems most probable that the 45 A. reflexion can be ascribed to a net-plane coinciding with the 'grid' formed by the backbone and the hydrogen bonds[3]. The other reflexions, except the 31 A. reflexion, the existence of which is still rather doubtful, represent the second, third, fourth and

fifth order of this reflexion. The fourth and fifth orders come to lie within the region of the A_1 interference of 'silk II', which is smeared out and is the inmost interference hitherto observed. In fact, A_1 has the same position in the lattice (that is, coinciding with the backbone – H-bond-grid) and seems to split, at least partially, into the new sharper interferences.

It seems possible to interpret the appearance of this large period within the direction of the side-chain on the grounds of absorption measurements with polarized ultra-violet light[4]. These experiments show that once 'silk III' has formed, the planes of the tyrosine residues are oriented in one plane containing the fibre axis. Closely connected with this orientation, an increase of phenolic dissociation of the tyrosine molecules occurs probably in consequence of formation of salt bridges or hydrogen-bonds.

According to Bergmann and Niemann[5], every sixteenth amino-acid along the peptide-chain is a tyrosine residue. Furthermore, the large period in the direction of the side-chain contains 8–10 peptid-grids, if one assumes the same steric arrangement of the peptide-chains for 'silk II' and 'silk III'.

There exist various possibilities of a steric correlation between these two facts, whereas the formation of a large period could scarcely be explained on the basis of the simple glycyl–alanine lattice assumed hitherto by many authors.

We have learned from a private communication that H. Zahn has observed similar changes in X-ray diagrams of silk treated with nitric acid.

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Viridin

Viridin, an antibiotic produced by a pigment-forming strain of the common soil fungus *Trichoderma viride*, was first described by Brian and McGowan[1], and Brian, Curtis, Hemming and McGowan[2]. Viridin is not anti-bacterial but is highly antifungal. Its activity against certain fungi is remarkably high. Germination of the spores of, for example, *Botrytis allii* is prevented by a concentration of 0·019 p.p.m. of α-viridin or 0·156 p.p.m. of β-viridin. Among synthetic fungicides, only the organo-mercurials are of the same order of activity.

Several methods have been tried for the isolation and purification of viridin. The procedure described here provides viridin in good yields and gives reproducible results. Viridin was extracted from the culture filtrate with chloroform. After evaporation of the chloroform extract under reduced pressure and treatment of the oily residue with ice-cold methanol, a crystalline, slightly coloured material was isolated.

Viridin reacts with ketonic reagents, although all attempts to obtain crystalline derivatives have so far been unsuccessful. However, viridin reacts readily with Girard's reagent[3], by means of which separation of ketonic from non-ketonic material can be achieved. The ketonic part was further purified by chromatography (method of fractional elution). On neutral or weakly acid alumina, far-reaching degradation was observed. It was thus necessary to use a strongly acidic alumina column. On such a column, it was possible to separate viridin into α- and β-viridin, although the quantity of the latter compound was variable and usually of a very small order.

The α-isomer was isolated from the benzene – ether eluate. After recrystallization from methanol, acetone and finally dilute acetic acid, α-viridin was obtained as fine, colourless needles, decomposition point 208–217° C., determined on a Kofler block. α-Viridin, which contains no nitrogen, no halogen, no sulphur and no phosphorus, does not decolorize bromine in the cold, produces no coloration with tetranitro-methane, gives no reaction with Schiff's reagent or 1 : 4-dihydroxy-naphthalene, but reduces Fehling's solution and Tollens's reagent in the cold. It does not give a positive iodoform reaction. With concentrated sulphuric acid, it produces an orange-red colour, which on warming changes to a deep red. It is soluble in cold caustic soda, forming a red solution.

Analyses and molecular weight determinations reveal that the hitherto accepted molecular formula should be replaced by $C_{19}H_{16}O_6$. Viridin contains one methoxy- but no acetyl-group as previously assumed. Zerewitinoff determinations disclose the presence of two active hydrogen atoms. On hydrogenation in glacial acetic acid in presence of Adam's catalyst or in alcohol with palladium charcoal, 7 mol. hydrogen are taken up. α-Viridin is optically active, $[\alpha]D^{20} = -213{\cdot}4°$ (chloroform); it shows two absorption bands in the ultra-violet: I, $\lambda_{max.}$ 3045 A., $\varepsilon = 13{,}200$; II, $\lambda_{max.}$ 2413 A., $\varepsilon = 31{,}000$ (alcohol).

Further evidence for the empirical formula $C_{19}H_{16}O_6$ was adduced by the preparation of a diacetyl derivative (m.p. 145–50° C.), the analyses of which were in agreement with $C_{23}H_{20}O_8$. From this a 2 : 4-dinitrophenylhydrazone (m.p. 271–73°) was obtained which agreed with $C_{29}H_{24}O_{11}N_4$, thus further confirming the revised formula for viridin.

β-Viridin was isolated from the chloroform eluates. After recrystallization from methanol β-viridin forms fine needles. β-Viridin has the same composition as α-viridin and differs only in its optical rotation, $[\alpha]D^{20} = -50{\cdot}7°$ (chloroform) and melting point (140° C.). The two compounds also have identical absorption spectra: I, $\lambda_{max.}$ 3040 A., $\varepsilon = 13{,}200$; II, $\lambda_{max.}$ 2415 A., $\varepsilon = 31{,}000$ (alcohol).

An attempt to separate the α- and β-isomer by paper chromatography was unsuccessful.

Details of this and further work will be published elsewhere. We are grateful to Dr. P. W. Brian and Mr. P. J. Curtis for their co-operation in supplying the starting material and in undertaking the biological tests.

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The Frythe, Welwyn, Herts.
Nov. 30.

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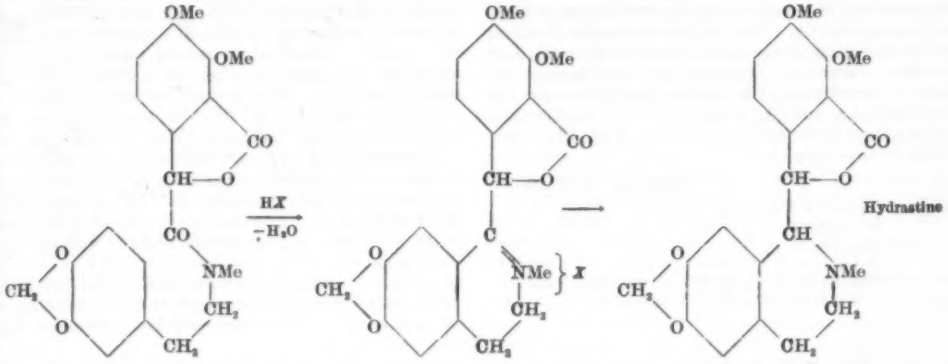
Synthesis of Hydrastine

CONDENSATION of nitromeconine and hydrastinine gave a mixture of nitrohydrastines, which was reduced and the product separated into aminohydrastines-*a* and -*b* [1]. By the removal of the amino-groups, *dl*-hydrastine-*a* (m.p. 137°) and *dl*-hydrastine-*b* (m.p. 150–51°) were obtained, but at that time neither of these inactive stereoisomerides could be resolved.



However, by partial racemization of natural *l*-hydrastine an optically active stereoisomeride was obtained, and a comparison of the rotatory powers made it clear that natural hydrastine and natural narcotine are of different stereochemical configuration[2]. Adopting the convention that natural narcotine is *l*-α-narcotine, partially racemized to *l*-β-narcotine, natural hydrastine was considered to be *l*-β-hydrastine partially racemized to *l*-α-hydrastine.

The racemization phenomena and the comparison of physical properties of *dl*-amino-β-narcotine with supposed *dl*-amino-β-hydrastine suggested that hydrastine-*a* was *dl*-β-hydrastine. As *dl*-α-narcotine (gnoscopine), but not *dl*-β-narcotine, could be resolved, it was expected that hydrastine-*b* should first be split into enantiomorphs and that natural *l*-hydrastine would then be obtained by partial racemization of one of these. This anticipation has not been realized; but instead, hydrastine-*a* has been directly resolved, and in this way the synthesis of natural hydrastine has been completed.

The present note is a preliminary announcement which will clear the way for publication of independent work in our two laboratories.

At Sheffield a new synthesis of hydrastine and other phthalide-*iso*quinoline alkaloids has been developed. The substituted β-phenylethylmethylamide of a substituted phthalidecarboxylic acid is suitably dehydrated with ring-closure and then reduced[3]. Thus for the synthesis of hydrastines the stages are as shown in the scheme above.

Both hydrastine-*a* (m.p. 138–39°) and hydrastine-*b* (m.p. 151–52°) were obtained in this way, and these melting points were not depressed on admixture with hydrastine-*a* and hydrastine-*b*, respectively, prepared by the earlier method[1].

Hydrastine-*a* was resolved in the course of this work with the aid of *d*-camphor-π-sulphonic acid, and natural hydrastine was proved to be identical with the product.

The resolution at Oxford by means of *d*-bromocamphorsulphonic acid also afforded a small yield of natural hydrastine, but the process employed was complicated by recovery and loss of material, and a better method is sought.

There is a great contrast in the ease of resolution of phthalide-*iso*quinoline alkaloids.

x-Bicuculline[4] has been completely resolved into components, one of which is identical with natural bicuculline (Oxford, collaboration with R. H. F. Manske), with the greatest of ease by crystallization of the hydrogen *d*- and *l*-tartrates. On the other hand, the two *dl*-cordrastines synthesized by the new method (Sheffield) could not be resolved.

A clean separation of hydrastine-*a* into its components is not easy to effect and the same is true of gnoscopine (*dl*-α-narcotine), though in this latter case the difficulty is confined to securing a crystal of the salt of the active base.

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Dec. 14.

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Paper Chromatography of some Acridines

PARTITION chromatography on paper has proved of such general use in biochemistry that, for the time, adsorption chromatography seems to have been neglected. Datta and Overell[1] have recently shown, however, that vitamin A and its derivatives can be chromatographed on filter paper impregnated with alumina, whereas, owing to the high solubility in lipoid solvents, partition chromatography is unsuccessful. Even the addition of alumina to the paper is in many cases unnecessary, as was shown by Goppelsroeder[2] so long ago as 1910. As in ordinary chromatography, the adsorption and elution are governed by the solvent used.

In this communication the separation of pairs of acridine dyes is described. The dyes examined are chemotherapeutic agents, the identification of which in mixtures may be required in the course of clinical research. The acridines examined were atebrin, acriflavine and monacrin (5-amino-acridine hydrochloride), and by development either with water or

aqueous hydrochloric acid good separations of pairs of these were obtained. In partition chromatography with various solvents, no separations were obtained, all the dyes travelling with the solvent front.

When a mixture of atebrin and monacrin or atebrin and acriflavine is treated by ascending development with dilute hydrochloric acid on a strip of No. 1 Whatman paper, the atebrin travels fairly quickly with the solvent, leaving the other dye behind. Mixtures of acriflavine and monacrin are not separated by hydrochloric acid; however, by development with water a separation is effected, the monacrin forming a light yellow zone immediately in front of the darker acriflavine. Mixtures of atebrin and acriflavine also separate if developed with water, the lighter atebrin again forming a zone just ahead of the acriflavine.

I wish to thank Bayer Pharma Pty., Ltd. (Sydney), for gifts of acridines.

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Dec. 10.

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The Calomel Electrode

THE silver/silver chloride electrode has been preferred to the calomel electrode for precise potentiometric work, and E^0 for the cell H_2, | Pt | HCl(aq.) | Hg_2Cl_2 | Hg has not been directly determined with any degree of accuracy. Nevertheless, mercury suffers from none of the difficulties associated with purity and thermal or mechanical history which affect silver and other hard metals. Attempts have been made to remedy the defects of the calomel electrode in order to make use of this advantage, and have been so far successful as to warrant a preliminary report.

The conditions which we have found to be necessary for the reversible operation of the calomel electrode are as follows:

(1) The solutions must be deoxygenated[1]. The effect of oxygen is marked, but reversible, except for the slow reaction $2Hg + 2HCl + \frac{1}{2}O_2 = Hg_2Cl_2 + H_2O$.

(2) It is necessary to use only a very thin layer of calomel, with which the solution need not be presaturated. Quantities of calomel–mercury–solution paste are harmful.

(3) The electrode vessel must be hydrophobic to prevent the penetration by capillary action of solution between the mercury and the walls of the containing vessel. If this penetration is allowed to occur, the mercury/bulk solution interface may well become subsidiary to the large mercury/annular liquid film interface which is formed. The potential difference at this new interface is not governed by the bulk solution, from which the liquid film is segregated, and is subject to magnified effects of adsorption, ion-exchange, etc. It has been established that capillary penetration gives rise to highly erratic behaviour in calomel electrodes, particularly when acid solutions are involved. Treatment of electrode vessels with Dow–Corning 'Silicone Fluid 200' is effective in eliminating this difficulty, and it is suggested that mercury electrodes of many kinds might be improved by similar treatment.

(4) Calomel of particle size 1–5 μ, electrolytically prepared[2] or chemically precipitated, must be used. Commercial calomel of larger crystal-size is unsatisfactory, giving rise to errors in the opposite sense to those expected from a normal dependence of solubility on particle-size. Calomel in the presence of mercury undergoes slow deterioration with the formation of yellow basic salt[3]; electrodes prepared from such material show large positive errors.

(5) The calomel and mercury must be shaken vigorously together under dry conditions, and a small amount of the grey, adherent skin so formed must be added to the clean, dry mercury which is to be used for the electrode. Immediate spreading of the added calomel skin occurs and a satisfactory electrode is formed by careful addition of the deaerated solution. The dry interaction appears to be essential; addition of the solution to the mercury before the calomel leads to an unsatisfactory electrode.

If these conditions are followed, the electrode is reproducible in potential to ± 0·01 mV. and is stable almost indefinitely, whereas the defects arising from their neglect may give rise to errors of several millivolts. These improvements have enabled us to determine the E^0 of the hydrogen–HCl–calomel cell at 25° C. by direct extrapolation; the preliminary value is 0·26808 absolute volt, with a probable error of ± 0·01 mV. The work will be reported in full in the near future.

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Centrifugal Ultra-filtration

IN the course of preparing ultra-filtrates from blood and plasma for the purpose of estimating amino-acids, we have found that serious losses can occasionally occur when collodion sacs are used. Individual amino-acid concentrations in the ultra-filtrates from control aqueous solutions containing no protein may often be reduced by 50 per cent or more. The amino-acids investigated were arginine, histidine, tryptophane and ergothioneine.

In order to overcome the difficulty, we originally tried standardized flat disk-shaped 'Gradocol' membranes, under high pressures. Pressures as high as 40 atmo. failed to give a reasonable rate of filtration with a 1 in 4 dilution of blood or plasma in water. An alternative form of apparatus using the principle of centrifugal ultra-filtration was, therefore, devised by one of us (A. L. L.). It consists of a steel tube with numerous perforations and fitted with a lip, supported in a glass centrifuge tube by means of a metal disk. The collodion sac attached to a rubber bung is inserted, so that the bung fits tightly into the open end of the metal tube. Before insertion, the sac is filled with the material to be ultra-filtered (usually 1 part plasma or blood in 3 parts water). The tube is centrifuged at 1,500 rev./min., and filtration takes place under the influence of the centrifugal force. In this manner rapid rates of filtration can be obtained without apparent blocking of the pores of the membrane by protein.

The preliminary success of this mode of ultra-filtration suggested to one of us (E. B. S.) an apparatus, employing a similar principle, which is constructed in one piece and entirely of glass. It consists essentially of a fluted glass centrifuge tube, into which the sac is placed as before. The lands of the fluted interior grip and support the sac-shaped membrane, and ultra-filtration takes place into the grooves. Additional support may, if necessary, be given to the bottom of the sac by either constriction of the tube or insertion of a short glass support. Results have been obtained comparable with those obtained with the previous apparatus.

The return to the idea of a sac-shaped membrane re-introduced the problem of preparing such membranes suitably permeable to amino-acids or to any other substances which it is required to ultra-filter. After trying many methods of preparation, we found sacs prepared by the method of Adair[1] were most suitable for the purpose of recovering amino-acids, although as an additional precaution a test run with a control solution should always be made on each sac.

An apparatus is now being designed in which the same principle of centrifugal ultra-filtration may be applied with flat 'Gradocol' membranes of standard pore size.

We wish to acknowledge the help we have received from Mr. F. Robinson of the Department of Engineering, King's College, Newcastle upon Tyne, and also from Messrs. James Jobling and Co., Wear Glassworks, Sunderland, the makers of 'Pyrex' glassware. We are also indebted to King's College, Newcastle upon Tyne, for a research grant to one of us (E. B. S.).

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Oogamy in a Centric Diatom

Early in October 1947 *Melosira varians* was found in mass production of auxospores in the Botanical Gardens of Darmstadt in the Darm brook. Material was treated with aceto-carmine and, for want of the normal reagents, mounted via methanol-toluene in 'Koniferenbalsam' (Merck). Upon re-examination this spring, only one of the slides proved good enough to allow full analysis of the critical stages preceding auxospore formation. Fortunately it contained an abundance of them.

A thorough study of this preparation and an adequate interpretation of the earlier work of Persidsky[1] gives the following picture of the sexual processes in this diatom. *Melosira* exhibits narrow male and, on the average, broader female filaments. There seems to be no lower breadth limit that prevents vegetative cells from becoming microsporangia (= antheridia), as occurs for the formation of auxospore mother-cells or oogonia. Where male and female breadth variation curves are overlapping, about 9 per cent of the filaments are monœcious.

The antheridium mother-cells show strikingly lower valvæ than both vegetative and female cells; the broader ones are nearly square in section, their plasm and plastid content being very small. Their nuclei, after moving towards the cell-equator in early diakinesis, undergo reduction divisions. Two spermatozoid mother-cells bud off the main cytoplasm in second metaphase, then divide into the four spermatozoids. After having detected them in the stained material, I succeeded in finding one living ripe antheridium on May 22, 1949, during a short auxospore epidemic: four globular plastidless spermatozoa in rapid rotating motion were cornered by the residual cytoplasm, the latter containing five to six yellowish chromatophores and a funotioning tonoplast. The cell unfortunately died after short observation. Flagella were not seen either in this living antheridium or in the fixed ones, but they, of course, are to be assumed. Mature antheridia are very rare both in living and in stained material; they seem to open very quickly after formation by means of the tonoplast. Antheridia of *M. varians* have been drawn from permanent preparations by Persidsky[1], who interpreted them as tetrad stages preceding autogamous karyogamy in auxospore mother-cells. But it is impossible to assume continuity among both kinds of cells; for example, because of the difference of shape between their valvæ. Perhaps Rieth[2] observed the same organs in his "8-Kernstadien" of *M. arenaria*. But in the living condition they have, to my knowledge, never before been described. Indeed, they might scarcely be suspected to be propagative organs, with their resemblance to degenerating cells. Schmidt's[3] "microsporangia" of *M. varians* seem to have been parasitized cells.

Young oogonia resemble vegetative cells in shape, yet their plasma and their pigments are augmented. Their nucleii remain in the cavity of the epivalva during the whole course of meiosis and afterwards up to the completion of the first auxosporic valva. In telophase I, one of the daughter-nuclei gradually aborts and the other one swells to the rather achromatic interphase-nucleus, which later, probably in early second prophase, shows again diakinesis-like distribution of condensed split chromosomes. Their number is about 27, against a count of about 22 gemini in female and 25 in male diakinesis. After, or in, second telophase, one more nucleus becomes pycnotic. The two 'polar bodies' thus formed are digested slowly. The egg-nucleus attaches itself to the tonoplast and enlarges. Due to almost complete loss of chromatin it is often very difficult to demarcate against cytoplasm. Elongation of the auxospore mother-cell, beginning slowly in late diakinesis, stops during first metaphase and is finished quickly in anaphase I. In this process the hypovalva is pushed out of the epithecal connecting-band and, while this is going on, does not form its own connecting-band, in contrast to ordinary mitosis. So a strip of probably naked protoplasm is finally exposed between the margins of epitheca and hypovalva. Here spermatozoa, or at least their nuclei, may enter as early as in late anaphase I, or as late as in the earlier stages of the mature egg-nucleus. Later on the male nucleus, clearly distinguished by its structure from the 'polar bodies', ascends to the oogonial nucleus and is often found in its vicinity during and after the last steps of meiosis. At least it fuses with and dissolves in the egg-nucleus. Thenceforward no criterion could be found to discriminate between fertilized and virgin oogonia. The fate of unfertilized auxospore mother-cells, therefore, remains uncertain. Later, the protoplast of the auxospore mother-cell bursts the connecting-band and swells to form the subglobose auxospore.

M. varians is—contrary to Persidsky's[1] opinion, who assumed an autogamous act—oogamous and it is monœcious. Most observations on reproductive processes in centric diatoms seem to me to be in accordance with the assumption, first suggested by Went[4] and Geitler[5], that other members of this group may behave in a similar way.

A full account of these observations will be given elsewhere.

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Aug. 25.

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Electronic Heating and Control of Seed-borne Diseases

War-time developments in high-frequency dielectric heating seemed to offer new possibilities in the control of seed-borne plant disease. By this method the temperature of the whole of a mass of grain can be raised fairly uniformly. It should therefore be superior to earlier means of dry heating, where, owing to the low thermal conductivity of the sample, the centre of the mass does not attain the required temperature when the outside is correctly heated. Hot-water treatment can maintain the necessary temperature throughout the mass, but is a slow and costly process in commercial practice. A method of uniform dry heating would find its greatest application in the control of internal seed-borne fungal diseases such as loose smut of barley and wheat. Experimental work with such diseases, however, necessitates the development of new techniques for evaluating the effect of treatment. Preliminary work was therefore carried out with the seed-borne phase of leaf stripe of oats (*Helminthosporium avenæ*). The amount of this disease can be estimated fairly rapidly by growing the oats to the seedling stage, or by plating out the seeds in petri dishes.

Oats, var. Star, having a 13 per cent infection with leaf stripe (*H. avenæ*), and contained in a cardboard box having no metal parts, were placed between the electrodes of a standard *RH* 23 Redifon radio-frequency generator. They were heated to the required temperature and maintained at that value for a certain time, usually 20 min., the temperature being measured by means of a special thermometer not affected by the high-frequency radiation. The oats were then spread out to cool, and fifty seeds were sown in each of eight pans of sterilized sand. Subsequent growth in a cool greenhouse allowed the estimation of the number of plants showing the seedling blight phase of leaf stripe. This number was expressed as a percentage of the seedlings which grew, and the percentage germination was also calculated.

Results of a number of trials were somewhat variable, but Fig. 1 gives a typical indication of their nature. Heating at 60° C. for 20 min. reduced the amount of leaf stripe to about 50 per cent without greatly impairing the germination. Higher temperatures maintained for a similar period reduced the amount of the disease still further, but also depressed the germination in marked degree. Lower temperatures had little effect on the disease. Heating at 60° C. for longer periods affected the germination more than the leaf stripe:

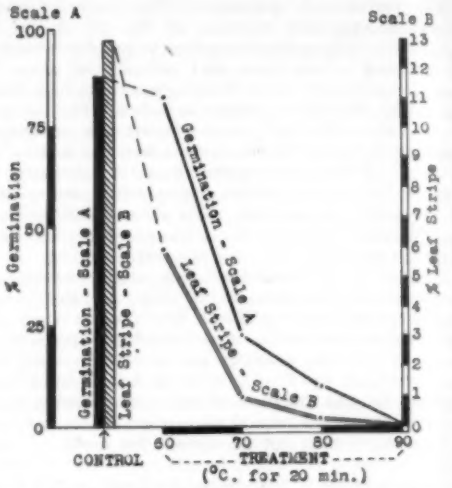

Fig. 1. Effect of radio-frequency heating on germination and on the amount of leaf stripe in oats

	% Germination	% Leaf stripe
Unheated control	87	13
Heated at 60° C. for 20 min.	85	6
Heated at 60° C. for 40 min.	81	5

Attempts to find a more critical time–temperature relation have so far not been successful. The moisture content of grain is probably important in this respect; results given in the table and in Fig. 1 were carried out with oats having 18·5 per cent moisture. Water-content of the grain also affects the rate of heating (Fig. 2).

Radio-heating seems to offer only a partial control of leaf stripe. The fungus causing this disease is

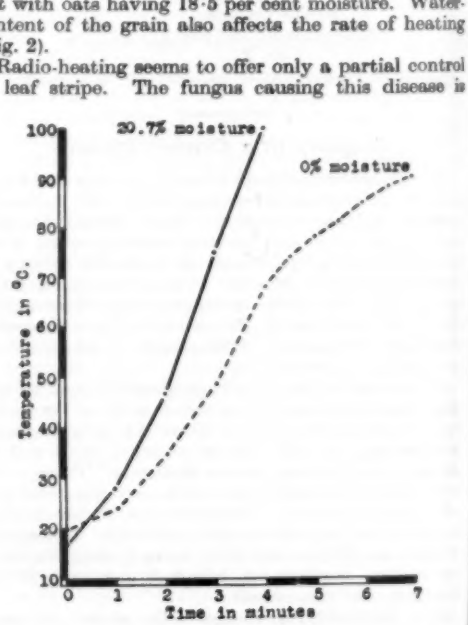

Fig. 2. Rates of heating of oat grains in radio-frequency generator for extremes of moisture content

external in the seed-borne phase, and can be controlled readily and almost completely by dry mercurial dressings. Some small advantage might accrue from control by a non-poisonous treatment; but, though radio-heating would provide this, the degree of control is not adequate for practical application. Work with loose smut of barley is now in hand, for if high-frequency heating is to have any advantage, it should be demonstrable with this internal seed-borne parasite.

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Effect of Quinhydrone on Soil Nitrification

Lees and Quastel[1] showed that if soils of temperate regions were submitted to an initial treatment with 4×10^{-3} *M* quinhydrone and afterwards rinsed with water to remove excess quinhydrone, they failed thereafter to nitrify percolated ammonium salts at the normal rate. It has since been found (Lees, unpublished results) that nitrification in these soils was inhibited by millimolar concentrations of quinhydrone allowed to percolate at the same time as ammonium salts. This latter result has now been confirmed by experiments with two soils from Trinidad: soil *A*, a fertile loam, and soil *B*, a poor heavy clay. Each soil had a *p*H of 7·0–7·4 and a soil organic matter content of 11–14 per cent.

Ten-gram samples of the 4·0–1·0 mm. fractions of the crumb layers of these soils were stimulated to nitrification in the standard way[2] and repercolated with 100-ml. lots of $2{\cdot}5 \times 10^{-3}$ *M* ammonium sulphate solution containing various concentrations of quinhydrone. The resultant nitrifications are shown in Fig. 1. It will be seen that nitrification was markedly inhibited by quinhydrone in concentrations as low as $1{\cdot}0 \times 10^{-4}$ *M*; in fact, quinhydrone had a toxicity towards nitrification of the same order as the toxicity of sodium azide (Fig. 2).

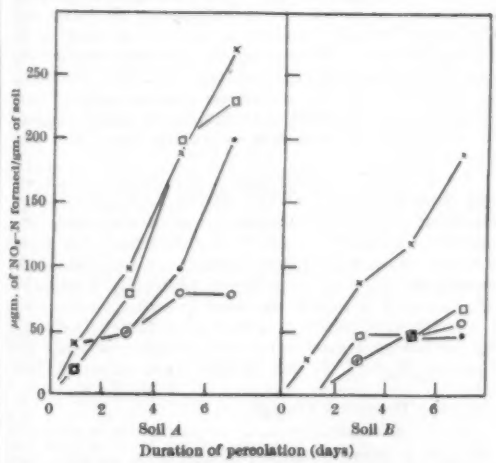

Fig. 1. Inhibition of nitrification by quinhydrone. Quinhydrone concentration of percolate: — × —, nil (control); — O —, $2{\cdot}5 \times 10^{-4}$ *M*; — ● —, $1{\cdot}0 \times 10^{-4}$ *M*; — □ —, $5{\cdot}0 \times 10^{-5}$ *M*

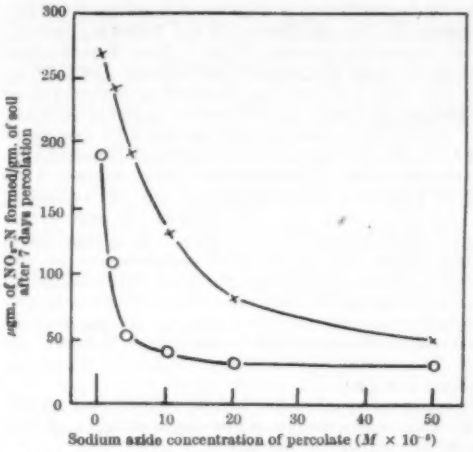

Fig. 2. Inhibition of nitrification by sodium azide: — × —, soil *A*; — O —, soil *B*

It is probable that in none of the experiments cited was quinhydrone itself the toxic agent, since a rapid darkening of the percolate during the first few hours of percolation, indicative of quinhydrone oxidation, was always observed. A search for the actual toxic agent among the quinones and polyphenols, possible oxidation products of quinhydrone, is now being conducted.

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Use of Lime and Sodium Molybdate for the Control of 'Whiptail' in Broccoli

IN the report in *Nature*[1] on the occurrence of 'whiptail' in cauliflower in Great Britain, it was stated that this deficiency disease, attributable to molybdenum[2,3], is endemic in south-eastern England. From observations and experiments carried out at this Station since 1947, 'whiptail' in cauliflower and broccoli is prevalent in most of the market-garden districts of the south of England and Wales, and particularly in the broccoli-growing areas of Cornwall. The problem occurs on acid soils, and a wide range of different parent materials is involved, including granite, Devonian shales and sandstones, Carboniferous Limestone and Lower Greensand.

As regards 'whiptail' in broccoli, the symptoms are characterized by a reduction and malformation of the lamina, excessive extension of the petioles and atrophy of the growing point.

Field experiments carried out during the past two years at centres in Cornwall and Wales have shown that while the incidence and severity of 'whiptail' is affected by the seasonal conditions, the application of lime or sodium molybdate to acid soils will prevent this trouble.

As the broccoli crop is of great economic importance to Cornwall, the significance of the following experiments warrants mention here. Two experiments (Centres *A* and *B*) carried out during 1949–50 in Cornwall with broccoli (var. Roscoff 2) included four treatments laid out in the form of a Latin square: (*a*) control, (*b*) sodium molybdate at 2 lb. per acre, and (*c*) 4 lb. per acre, and (*d*) ground limestone at 3 tons per acre. The soils at both centres were derived from Devonian shale, and the *p*H values of the soil with treatments (*a*), (*b*) and (*c*) were in the region of 5·0–5·5, and of (*d*) 6·0–6·5. It is considered unlikely that the amount of molybdenum in the lime would complicate the effects of this treatment, since a water-soluble analysis of the limestone gave a molybdenum content of 0·2 p.p.m. At the rate of limestone application, this would supply 0·4 gm. per acre. The minimum requirement of a crop of broccoli is about 5·0 gm.

A count of marketable heads, rejects and 'whiptails' was made previous to harvesting, and the results are shown in Table 1.

Table 1. Number of 'Whiptails' Prior to Harvesting

Centres	Treatment											
	Control			Sodium molybdate, 2 lb./acre			Sodium molybdate, 4 lb./acre			Ground limestone		
	M (per cent)	*R*	*W*	*M* (per cent)	*R*	*W*	*M* (per cent)	*R*	*W*	*M* (per cent)	*R*	*W*
A	51	10	39	81	11	8	89	9	2	85	10	5
B	64	5	31	89	6	5	95	5	0	88	5	7

M, Marketable heads; *R*, rejects; *W*, 'whiptail'

It can be seen that at both centres the sodium molybdate treatments reduced the incidence of 'whiptail' from 30–40 per cent on the controls to 0–8 per cent. Ground limestone gave similar results to sodium molybdate at 2 lb. per acre.

The chemical data from leaf material collected from the plants prior to 'curding' gave the following molybdenum and manganese contents (Table 2).

Table. 2. Molybdenum and Manganese Contents of Broccoli Leaves at Centre *A*

Treatment	Molybdenum (p.p.m.) in dry matter	Manganese (p.p.m.) in dry matter
(*a*) Control ('whiptail' plants)	0·08	410
(*b*) Sodium molybdate, 2 lb./acre	0·32	150
(*c*) Sodium molybdate, 4 lb./acre	0·39	215
(*d*) Ground limestone	0·35	40

The molybdenum content of the 'whiptail' leaves (0·08 p.p.m.) is of the same magnitude as found by Hewitt[4], who has recorded that 'whiptail' cauliflowers, produced experimentally, contained 0·02 p.p.m. molybdenum. It is interesting to note that the value of molybdenum in the leaves from limestone treatment (*d*) is approximately the same as in (*b*), where 450 gm. of molybdenum was applied.

The values of manganese are included since 'whiptail' is associated with an excess of manganese on acid soils. In these experiments no symptoms of manganese toxicity were recorded, nor are the amounts in the 'whiptail' leaves (400 p.p.m.) considered sufficient for this to happen. The lower values for manganese where the molybdenum contents have been raised are of interest in connexion with problems of crop failures on acid soils.

It appears from these experiments—and numerous observations would seem to support the finding—that molybdenum is of low availability in certain acid soils, and that the level can be substantially raised by liming. Thus in terms of practical husbandry, liming, if soil tests show the necessity, is the correct procedure when cauliflower or broccoli are to be grown.

The occurrence of 'whiptail' on soils with a neutral reaction would indicate that molybdenum was in short supply and that an addition of this element to the soil would be required.

The results of these investigations will be reported more fully at a later date. The work has been carried out under special grants made by the Agricultural Research Council, to which grateful acknowledgment is made.

W. Plant

Long Ashton Research Station,
Bristol.
Feb. 21.

[1] Jones, J. O., and Dermott, W., *Nature*, **165**, 248 (1950).
[2] Davies, E. B., *Nature*, **156**, 392 (1945).
[3] Hewitt, E. J., and Jones, E. W., *J. Pomology and Hort. Sci.*, **23**, No. 3 and 4 (1947).
[4] Hewitt, E. J., and Jones, E. W., Ann. Rept. Long Ashton Res. Stat. 1948, 81 (1948).

Qualifications in Applied Physics

It is obvious from recent articles in *Nature* and elsewhere that important decisions must inevitably be come to with regard to the precise province of the university and the technological institute with respect to technical education. However, the time has also come when it should be generally recognized that there exists to-day a missing link in the present classification of the categories of scientific qualification appropriate to modern requirements. I refer to the absence of a university degree in applied physics.

It is a strange fact that, in Britain, whereas B.Sc. degrees in applied chemistry (and chemical engineering) have been awarded for more than thirty-five years, no corresponding degree in applied physics has been instituted. It is interesting to learn that the need for such a degree is now recognized in the United States[1]. Moreover, in a recent report[2] by the Physicists' Sub-Committee of the Technical Personnel Committee under the chairmanship of Lord Hankey, it is stressed that there is a larger demand in industry for physicist-engineers than for pure physicists.

A four years associateship course in applied physics has been instituted at the Royal Technical College, Glasgow, but a wider recognition of the need for a degree in applied physics is long overdue. The introduction of such a degree would not only make for clearer thinking in the efficient planning of technical education, but would also lead to reducing the time-lag in the application of science to industry as stressed by Sir Henry Tizard in his presidential address, "The Passing World", to the British Association in 1948.

J. S. Rankin

Royal Technical College,
Glasgow.

[1] John, W. J., *Bosma J.* (Dec. 1949).
[2] Present and Future Supply and Demand for Persons with Professional Qualifications in Physics (London: H.M. Stationery Office).

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Monday, April 3

INSTITUTION OF ELECTRICAL ENGINEERS, EDUCATION DISCUSSION CIRCLE (at Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Discussion on "The Place of the Model in Teaching" (to be opened by Mr. D. G. Sandeman).

INSTITUTION OF ELECTRICAL ENGINEERS, NORTH-EASTERN RADIO AND MEASUREMENTS GROUP (at King's College, Newcastle-upon-Tyne), at 6.15 p.m.—Mr. F. J. V. Ritson: "Radar Automatic Tracking".

Monday, April 3—Wednesday, April 5

INSTITUTE OF PHYSICS, STRESS ANALYSIS GROUP (at University College, Gower Street, London, W.C.1), at 3.30 p.m.—Fourth Annual Conference.

Tuesday, April 4

CHADWICK PUBLIC LECTURE (at the Livingstone Hall, London Missionary Society, 42 Broadway, Westminster, London, S.W.1), at 2.30 p.m.—Mr. Charles E. Scholefield: "Rivers Pollution and the River Boards Act, 1948".*

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. A. H. M. Arnold: "Dielectric Admittances in Transformers".

INSTITUTION OF ELECTRICAL ENGINEERS, NORTH-WESTERN CENTRE (at the Engineers' Club, Albert Square, Manchester), at 6.15 p.m.—Mr. L. H. A. Carr: "The M.K.S. or Giorgi System of Units—the Case for its Adoption"; Dr. E. Bradshaw: "Rationalized M.K.S. Units in Electrical Engineering Education".

MANCHESTER GEOGRAPHICAL SOCIETY (at the Geographical Hall, 16 St. Mary's Parsonage, Manchester), at 6.30 p.m.—Miss M. D. Leigh: "The Basques and their Country".

Wednesday, April 5

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Scientific Papers.

Thursday, April 6

CHEMICAL SOCIETY, ST. ANDREWS AND DUNDEE SECTION (in the Chemistry Lecture Theatre, University College, Dundee), at 5.15 p.m.—Dr. F. S. Dainton: "Chemical Reactions Induced by Nuclear Radiations".

INSTITUTE OF METALS (at 4 Grosvenor Gardens, London, S.W.1), at 7 p.m.—Discussion on "Creep" (to be opened by Dr. N. P. Allen).

Friday, April 7

CHEMICAL SOCIETY, ST. ANDREWS AND DUNDEE SECTION (joint meeting with the ST. ANDREWS UNIVERSITY CHEMICAL SOCIETY, in the Chemistry Department, United College, St. Andrews), at 5.15 p.m.—Prof. R. D. Haworth, F.R.S.: "Developments in the Chemistry of cycloHeptane Derivatives".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SENIOR ASSISTANT with a high honours degree in chemistry and specialized knowledge of either organic chemistry or inorganic and physical chemistry—The Registrar, Central Technical College, Suffolk Street, Birmingham (April 8).

SCIENTIST (Grade III), with an honours degree in science, preferably in chemistry or physics, or equivalent qualification, to assist in the collection, interpretation and dissemination of scientific information, and to prepare reports (Ref. TT/197), and a SCIENTIFIC TECHNOLOGIST (Grade II), with a Higher School Certificate, preferably with physics and chemistry, or equivalent qualification, to assist in the collection of scientific information (Ref. TT/198)—The National Coal Board, Establishments Branch (Personnel), Hobart House, Grosvenor Place, London, S.W.1, quoting the appropriate Ref. No. (April 10).

CHEMIST (with a University degree in chemistry or equivalent qualification)—The Engineer and Manager, City of Norwich Water Department, City Hall, Norwich (April 12).

SCIENTIFIC OFFICER (Chemist) in the Food Infestation Control Section in Glasgow of the Department of Agriculture for Scotland—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.271/49A (April 12).

DEPUTY DIRECTOR and KEEPER OF THE NATURAL SCIENCE DEPARTMENT—The Director, Museum and Art Galleries, Paisley (April 13).

PRINCIPAL SCIENTIFIC OFFICER or SENIOR SCIENTIFIC OFFICER at the Atomic Energy Research Establishment, Harwell, for duties with a research team engaged on developing methods for treatment of effluents containing inorganic wastes—The Secretary, Civil Service Commission, Scientific Branch, 7th Floor, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3013 (April 13).

SENIOR PRINCIPAL SCIENTIFIC OFFICER to develop and take charge of research on mechanisms and engineering metrology, and a SENIOR PRINCIPAL SCIENTIFIC OFFICER to develop and take charge of research on the properties of engineering materials, mechanics of solids, stress analysis, and vibration problems, in the Mechanical Engineering Research Organisation of the Department of Scientific and Industrial Research (initially at the National Physical Laboratory, Teddington, and ultimately at East Kilbride, near Glasgow)—The Secretary, Civil Service Commission, Scientific Branch, 7th Floor, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3001 (April 14).

GEOLOGISTS (6, Grade II) in the Commonwealth of Australia Bureau of Mineral Resources, Geology and Geophysics—The Senior Representative, Department of Supply and Development, Canberra House, 85–87 Jermyn Street, London, S.W.1 (April 14).

DIRECTOR OF THE CENTRAL STATISTICAL OFFICE to be set up by the Government of Pakistan—The High Commissioner for Pakistan, 35 Lowndes Square, London, S.W.1 (April 15).

PROFESSOR OF PHYSICS, a PROFESSOR OF BOTANY, and a PROFESSOR OF GEOLOGY, at Fouad I University—The Director, Egyptian Education Bureau, 4 Chesterfield Gardens, London, W.1 (April 15).

SENIOR RESEARCH OFFICER, Coal Research Section, Commonwealth Scientific and Industrial Research Organization, Sydney, to be responsible for research on the determination of the physical properties of Australian coals—The Chief Scientific Liaison Officer, Australian Scientific Research Liaison Office, Africa House, Kingsway, London, W.C.2, quoting No. 1987 (April 15).

SENIOR SCIENTIFIC OFFICER or SCIENTIFIC OFFICER (with an honours degree or equivalent in Engineering, with practical experience preferably in the design and use of unit mechanical handling systems) at a Ministry of Supply Research Establishment in the London area—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting C.684/49 (April 15).

PHYSIOLOGISTS (Senior Scientific Officer or Scientific Officer grade) at a Ministry of Supply Research Establishment in Hampshire, to carry out applied research connected with development of military clothing and equipment—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting G.62/50 (April 17).

ASSISTANT LECTURERS (2) IN BOTANY, an ASSISTANT LECTURER IN CHEMISTRY, an ASSISTANT LECTURER IN GEOGRAPHY, an ASSISTANT LECTURER IN GEOLOGY, ASSISTANT LECTURERS (2) IN MATHEMATICS, an ASSISTANT LECTURER IN PHYSICS, and an ASSISTANT LECTURER IN ZOOLOGY—The Registrar, University College, Hull (April 18).

LECTURER IN ZOOLOGY—The Registrar, King's College, Strand, London, W.C.2 (April 22).

PRINCIPAL RESEARCH OFFICER in the Division of Industrial Chemistry, Melbourne, to undertake theoretical studies in the fields of quantum and statistical mechanics, in particular their application to the theory of solids (Ref. No. 1689), and a RESEARCH OFFICER in the Building Research Section, Melbourne, for the mathematical treatment of problems associated with building research, such as wave acoustics, heat transfer, stress analysis and rheology (Ref. No. 2320)—The Chief Scientific Liaison Officer, Australian Scientific Research Liaison Office, Africa House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (April 22).

RADIOCHEMICAL INSPECTOR (with a good honours degree in Chemistry and substantial research experience) on the staff of the Ministry of Health—The Secretary, Civil Service Commission, Scientific Branch, 7th Floor, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3018 (April 27).

MATHEMATICIAN (Principal Scientific Officer or Senior Scientific Officer grade) with experience of gas dynamics for work on heat transfer problems and study of internal ballistics of solid propellant rocket motors (Ref. A.92/50), a PHYSICIST (Principal Scientific Officer or Senior Scientific Officer grade) with experience in gas dynamics to study problems in this field relating to rocket motors (Ref. A.93/50), and a CHEMIST (Senior Scientific Officer or Scientific Officer grade) for research and development work on solid propellant rocket motors (Ref. F.216/50), in a Ministry of Supply Research Establishment in the Home Counties—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (April 28).

ASSISTANT LECTURER IN MATHEMATICS, an ASSISTANT LECTURER IN CHEMISTRY (with special qualifications in Physical Chemistry), an ASSISTANT LECTURER IN PHYSICS, ASSISTANT LECTURERS (2) IN GEOLOGY, and a LECTURER or ASSISTANT LECTURER IN ELECTRICAL ENGINEERING—The Registrar, The University, Sheffield (April 29).

LECTURER IN ZOOLOGY—The Secretary, The University, 38 North Bailey, Durham (April 29).

LECTURER IN ELECTRICAL ENGINEERING—The Registrar, Queen Mary College, Mile End Road, London, E.1 (April 29).

SENIOR EXPERIMENTAL OFFICER (with degree or equivalent qualification in chemistry or engineering, and experience and interest in library and information bureau work) at a Ministry of Supply Research and Development Establishment near London, to take charge of Library and Information Services—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.198/50A (April 29).

LECTURER and an ASSISTANT LECTURER IN THE DEPARTMENT OF MATHEMATICS, University College, Ibadan—The Secretary, Inter-University Council for Higher Education in the Colonies, 1 Gordon Square, London, W.C.1 (April 30).

LECTURERS IN BIOCHEMISTRY, PHYSICS, PHYSIOLOGY, and ASSISTANT LECTURERS IN GENETICS, PHYSIOLOGY, ZOOLOGY—The Secretary of University Court, The University, Glasgow (April 30).

ASSISTANT LECTURER (woman) IN MATHEMATICS—The Principal, Royal Holloway College, Englefield Green, Surrey (May 1).

ASSISTANT LECTURER IN APPLIED MATHEMATICS—The Registrar, The University, Leeds 2 (May 1).

OFFICIAL FELLOW AND TUTOR IN PHYSICS—The College Secretary, Balliol College, Oxford (May 1).

TUTORIAL RESEARCH STUDENTSHIPS IN MATHEMATICS (pure or applied) AND BOTANY—The Principal, Royal Holloway College, Englefield Green, Surrey (May 1).

ASSISTANT LECTURERS IN MATHEMATICS, one with qualifications in Pure Mathematics and one with qualifications in Applied Mathematics—The Registrar, The University, Manchester 13 (May 8).

LECTURER and an ASSISTANT LECTURER IN PHILOSOPHY, and a LECTURER IN CHEMISTRY with special interests in the physical aspects of organic chemistry—The Registrar, The University, Manchester 13 (May 8).

UNIVERSITY LECTURER IN BIOCHEMISTRY—The Secretary, Appointments Committee of the Faculty of Biology 'B', Department of Pathology, Tennis Court Road, Cambridge (May 10).

ASSISTANT LECTURER IN GEOLOGY, with qualifications in Palæontology, and an ASSISTANT LECTURER IN BOTANY (physiologist and cytologist)—The Registrar, Queen Mary College, Mile End Road, London, E.1 (May 12).

RESEARCH FELLOWSHIP IN PURE SCIENCE—The Secretary, The University, Durham (May 14).

LEVERHULME STUDENTSHIPS IN CHEMICAL ENGINEERING—The Secretary, University College, Gower Street, London, W.C.1 (May 15).

PROFESSOR OF AGRICULTURE (Soil Science) at the Canterbury Agricultural College, University of New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (May 15).

SENIOR LECTURER IN PHYSIOLOGY at the University of Otago, Dunedin, New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (May 15).

SENIOR LECTURER IN ENGINEERING THERMODYNAMICS at the University of Queensland, Brisbane—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (Brisbane, May 17).

PRINCIPAL SCIENTIFIC OFFICER (with a good honours degree or equivalent qualification in Physics, Mathematics or Electrical Engineering) at out-station of Royal Aircraft Establishment in Southern England, for the administration of and technical responsibility for a range dealing with measurement of parameters occurring in flight of guided and unguided rockets—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting A.86/50 (May 24).

GEOLOGISTS (9) at the Geological Survey and Museum—The Secretary, Civil Service Commission, Scientific Branch, 7th Floor, Trinidad House, Old Burlington Street, London, W.1, quoting No. 2985 (May 31).

ASSISTANT EXPERIMENTAL OFFICER to assist with the Drosophila research programme—The Executive Assistant, Animal Breeding and Genetics Research Organisation, King's Buildings, West Mains Road, Edinburgh 9.

ASSISTANT LECTURER AND DEMONSTRATOR IN THE DEPARTMENT OF PHYSICS—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

ASSISTANTS IN THE JUNIOR TECHNICAL SCHOOLS and in the Khartoum Technical Institute in the Department of Engineering in the Sudan—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Technical Assistants (Engineering)'.

BIOCHEMIST (with a good honours degree, preferably a higher degree, and some research experience) for research on bacterial toxins and related problems, and an ASSISTANT BIOCHEMIST (with a good degree in chemistry and experience of modern biochemical techniques)—The Secretary, Middlesex Hospital Medical School, London, W.1.

DIRECTOR OF THE BOTANIC GARDEN—The University Registry, Cambridge.

EXPERIMENTAL OFFICER (female preferred) IN THE DEPARTMENT OF INSECTICIDES AND FUNGICIDES (qualifications in chemistry and biology essential)—The Secretary, Rothamsted Experimental Station, Harpenden, Herts.

LECTURER (with University teaching experience and a published record of research in quantum theory) IN APPLIED MATHEMATICS, a LECTURER (with a good honours degree in Geography and experience in University teaching and research) IN THE DEPARTMENT OF GEOGRAPHY, an ASSISTANT LECTURER IN GEOLOGY, and an ASSISTANT LECTURER IN PHILOSOPHY—The Registrar, University College, Southampton.

LECTURER (Grade IIa) IN CHEMISTRY—The Clerk and Treasurer, Dundee Technical College, 40 Bell Street, Dundee.

MUSEUM TECHNICAL INSTRUCTOR by the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M.N.22382/3E.

PHYSIOLOGIST or BIOCHEMIST to undertake work on climatology, and on metabolism of farm animals—The Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire.

SENIOR PHYSIOLOGIST to engage in full-time research on fundamental problems related to the physiology of the nervous system—The Secretary, Welsh Regional Hospital Board, Temple of Peace and Health, Cathays Park, Cardiff.

STATISTICIAN in the Research Division of the Ministry of Agriculture, Sudan—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Statistician'.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Museum (Natural History). Economic Series No. 3 : Fleas as a Menace to Man and Domestic Animals; their Life-History, Habits and Control. Sixth edition. Pp. 18. 6*d*. Economic Series No. 5 : The Bed-Bug; its Habits and Life-History and How to Deal with It. Sixth edition. Pp. 18. 9*d*. (London : British Museum (Natural History), 1949.) [1512

The Effects of National Service. Verbatim Reports of Papers given at the BACIE Annual Conference, Ashridge, 2nd October 1949. By J. C. Jones, Major-General J. E. C. McCandlish, G. J. Nash and Graham Satow. Pp. 29. (London : British Association for Commercial and Industrial Education, 1949.) 1*s*. [1912

Journal of the Institute of Metals. Vol. 74, 1948. Edited by Lieut.-Colonel S. C. Guillan and Major W. G. Askew. Pp. xxxviii+804+57 plates. (London : Institute of Metals, 1948.) £3. [1912

Metallurgical Abstracts (General and Non-Ferrous). Vol. 15, 1948. Edited by Lieut.-Colonel S. C. Guillan and Major W. G. Askew. Pp. viii+750. (London : Institute of Metals, 1948.) £3. [1912

Linen Industry Research Association. Report of the Council, 1949. Pp. 20. (Lambeg, Co. Antrim : Linen Industry Research Association, 1949.) [2012

Department of Scientific and Industrial Research : Food Investigation. Technical Paper No. 1 : The Storage of Apples; Interim Report on Skin-Coatings. By A. C. Hulme. Pp. iii+28. (London : H.M. Stationery Office, 1949.) 9*d*. net. [2012

Colour and the Visual Measurement of Colour : the Story of the Lovibond Colour Scale. By A. J. Fawcett. Pp. 52. (Salisbury : The Tintometer, Ltd., 1949.) 1*s*. 6*d*. [2012

Year Book of the Textile Institute. No. 2, 1949–50. Pp. 258. (Manchester : Textile Institute, 1949.) 10*s*. to non-Members. [2012

Question. Edited by H. Westmann. Vol. 2, No. 2 : Man and Freedom? By John Lewis, Montgomery Belgion, W. Weidle, Ritchie Calder, Dr. E. B. Strauss and Kathleen Raine. (Published for the Present Question Conference, Ltd.) Pp. 133–273. (London : Hammond, Hammond and Co., Ltd., 1949.) 2*s*. 6*d*. net. [2112

Radio Industry Council. Specification No. RIC/1000/A : Choice of Materials for Radio and other Electronic Equipments and for Components Therein. Pp. 18. (London : Radio Industry Council, 1949.) 3*s*. 6*d*. [2812

Ministry of Fuel and Power. Reports of H.M. Inspectors of Mines for the Year 1947. North Western Division. Report by E. H. Fraser. Pp. iv+60+8 plates. 1*s*. 6*d*. net. East Midland Division. Report by W. B. Brown. Pp. vi+60+4 plates. 1*s*. 6*d*. net. (London : H.M. Stationery Office, 1949.) [2812

Fusible Alloys containing Tin. Pp. 24. (Greenford : Tin Research Institute, 1949.) Free. [2812

British Standard 1560 : 1949, Steel Pipe Flanges and Flanged Fittings for the Petroleum Industry. Pp. 78. (London : British Standards Institution, 1949.) 12*s*. 6*d*. net. [2812

Thirty Years of Rubber Research, 1919–1949. Pp. 28. (Croydon : Research Association of British Rubber Manufacturers, 1949.) [2812

Chelsea Polytechnic. Fifty-fourth Annual Report, Session 1948–49. Pp. 26. (London : Chelsea Polytechnic, 1949.) [2912

Other Countries

Mémoires de l'Académie Polonaise des Sciences et des Lettres. Classe des Sciences mathématiques et naturelles, Série B, Sciences naturelles, No. 15 : Peat Bogs of Polesie. By Stanisław Kulczyński. Translated by Witold H. Paryski. Pp. 356+46 plates. (Cracovie : Académie Polonaise des Sciences et des Lettres, 1949.) [1912

Government of Travancore. Administration Report of the Government Museum, 1123 M.E. Pp. 4. (Trivandrum : Government Press, 1949.) [2012

General Rural Health Survey, Singur Health Centre, 1944. By R. B. Lal and S. C. Seal. Pp. vi+323. (Calcutta : All-India Institute of Hygiene and Public Health, 1949.) [2012

Polska Akademia Umiejetnosci. Prace rolniczo-leśne. Nr. 46 : Znaczenie izoterm styczniowych dla rozprzestrzenienia *Eriosoma lanigerum* Hausm. (The Meaning of January Isotherms for the Distribution of *Eriosoma lanigerum* Hausm.) Napisal M. Gromadska. Pp. 8. 75 zł. Nr. 47 : Badania nad pokrojem i wełną czarnogłowych owiec miesnych (typu Hampshire) owczarni zarodowej w Komorowie na Dolnym Slasku, ze szczególnym uwzględnieniem warunków hodowlanych (Investigations concerning Body Conformation and Wool, with special attention to Breeding Conditions of the Hampshire Pedigree Flock in Komorów, Lower Silesia). Napisal Henryk Krzyżaniak. Pp. 132+2 plates. n.p. (Kraków : Polska Akademia Umiejetnosci, 1949.) [2012

Polska Akademia Umiejetnosci. Materialy do fizjografii kraju. Nr. 17 : Materialy do poznania piórolotków, 3, *Capperia fuscа* (Hofmann), 1898, w Polsce (*Lep., Alucitidae*). (Notes on the Plume Moths, 3, *Capperia fuscа* (Hofmann), 1898, in Poland, *Lep., Alucitidae*). Napisal Stanisław Adamczewski. Pp. 11. 75 zł. Nr. 18 : Przyczynek do znajomosci obyczajów lozówki (*Acrocephalus palustris* Bechstein). (A Contribution to the Knowledge of the Habits of the Marsh-Warbler, *Acrocephalus palustris* Bechstein.) Napisal Bronisław Ferens. Pp. 28+1 plate. 180 zł. Nr. 19 : Z poszukiwań florystycznych w powiecie czestochowskim (Recherches floristiques dans le district de Czestochowa). Napisal Henryk Błaszczyk. Pp. 7+1 plate. 60 zł. Nr. 20 : Zapiski florystyczne z Tatr (Notulae ad floram Tatrorum pertinentes). Napisal Bogumił Pawłowski. Pp. 44. n.p. (Kraków : Polska Akademia Umiejetnosci, 1949.) [2012

Koninklijk Nederlands Meteorologisch Instituut. Mededelingen en Verhandelingen. Series A, 53 : Het Klimaat van Nederland, Temperatuur/Neerslag en Wind (The Climate of the Netherlands, Temperature/Precipitation and Wind). Door Dr. Ir. A. Labrijn. Pp. 71. 2.50 f. Series A, 54 : Electrische Ladingen aan Berijpte Oppervlakken (Electric Charges on Rime-covered Surfaces). Door Dr. C. Kramer. Pp. vii+128. 3 f. Serie A, 55 : Statistisch Onderzoek naar de Samenhang tussen het Weer, de Grasproductie en de Melkaanvoer (Statistical Research on the Correlation between the Weather, Grass-production and Milk-supply). Door Dr. Ir. J. J. Post. Pp. vi+120. 3 f. Serie B, Deel 2, Nr. 12 : On the Formation of Drops in Clouds and Fog. By R. R. Vierhout. Pp. 20. 2.50 f. ('s-Gravenhage : Staatsdrukkerij- en Uitgeverijbedrijf, 1948–1949.) [2112

Koninklijk Nederlands Meteorologisch Instituut. Seismic Records at De Bilt. 33, 1945. Pp. vii+16. ('s-Gravenhage : Staatsdrukkerij- en Uitgeverijbedrijf, 1949.) 1 f. [2112

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Unesco. Rapports presentés au cours des débats sur l'Homme et ses aliments, Montevideo, Lima, Quito, Santiago du Chili. Pp. ii+103. First List of Scientific Papers published in Latin America, 1948 (1er volumen). Pp. xxxii+296. Scientific Institutions and Scientists in Latin America—Argentina (1er volumen). Pp. ii+222. Scientific Institutions and Scientists in Latin America—Puerto Rico y Colombia (1er volumen). Pp. ii+30+35. Scientific Institutions and Scientists in Latin America—Uruguay (1er volumen). Pp. ii+75. (Montevideo : Unesco Centro de Cooperación Científica para América Latina, 1949.) [2112